Engineering Record

A Weekly Journal Devoted to Civil Engineering and Contracting

PUBLISHED BY McGRAW PUBLISHING COMPANY, INC.

Volume 73 NEW YORK, SATURDAY, MARCH 4, 1916 Number 10

Good Roads Saved Paris

ENGINEERS in this country have known, in a general way, that good roads are a military asset, but very few, outside of Army circles, have realized the momentous part which the highway system around Paris has played in the destinies of France. Good roads were the big factor in stopping the great German drive at the beginning of the war, and prevented the investment of Paris by the Teutonic forces. This, in effect, is the significant statement made recently by Major Amos A. Fries, Corp of Engineers, U. S. Army, in an address at the National Conference on Concrete Road Building in Chicago. By the quickness of their mobilization and movements, said Major Fries, the Germans all but took Paris, which was saved only by General Joffre's skillful use of automobiles and the fine roads around Paris. By commandeering all sorts of motor vehicles he was able to carry from Paris to the front for several days prior to and during the battle of the Marne a steady stream of soldiers, night and day. This turned the tide of invasion. The use which General Joffre made of good roads and motors at Paris in August, 1914, furnishes a lesson that this country should never forget.

Paving Factors of Safety

RECOGNITION of the added wear on pavement by motor buses was made in Chicago recently by a company seeking a franchise to operate over the boulevard system of the Lincoln Park Board. The offer to finance a $300,000 bond issue to repave the North Side system along Lake Michigan in exchange for a 25-year franchise to operate on the roads meets the most serious objection that the park officials heretofore have interposed against granting the right. The present paving, it has been contended, will not stand the heavy bus traffic. Agreements of this kind or monetary considerations will have to come sooner or later if the increasingly heavy traffic of special interests, as differentiated from that of the general public, is to be taken care of. Many of our paved streets now have little more than a factor of safety of one. Probably in no other class of engineering structure has the unity factor been approached with such rapidity, but ultimate rupture does not cause an accident and little attention is paid to a study of yield points. Yearly inspections of railroad bridges are made to ascertain the factor of safety which the members have under increased weight of the newest and heaviest rolling stock. The same practice is carried out in a more or less perfunctory way in highway bridges, but no one ever heard of a road inspection to see how heavy trucks it would carry, assuming a definite factor of safety. Trucks of 15 tons capacity, not at all unusual at present, cannot continue to operate over many suburban pavements without inflicting permanent injury. Is it not time now to determine what factor of safety different standard pavements have?

Plain Contracts for Philadelphia

MAYOR SMITH, of Philadelphia, in speaking recently before the Contractors' Association of that city, is reported to have said, in part: "I do not know of the past, whether there has been a favoring of certain contractors by means of changes in specifications or otherwise, but I do know that during the next four years the contracts and specifications will be so prepared that the veriest novice cannot fail to understand them." The Engineering Record hopes, for the sake of Philadelphia contractors, that the mayor's words will prove prophetic. What the owner, the engineer and the contractor need most today are specifications and contracts that "the veriest novice cannot fail to understand." Such documents should be so plain that they will tell all bidders at once the full and final object of the contract, the exact methods and standards by which that object is to be secured, and the precise business relations that will govern the co-operative efforts of the parties to the contract. If this be Mayor Smith's meaning, may his words come true, not only in Philadelphia, but on all municipal construction work.

"Fall In!"

ENGINEERS of New York who are planning to attend one of the military training camps at Plattsburg next summer will have an opportunity of receiving preliminary armory instruction in the rudiments of a soldier's duties during the next three months. This announcement was made Monday night at the military lecture in the Engineering Societies Building, given under the auspices of the four national engineering organizations. Further details are reported in the news section of this issue. The announcement means that the men who avail themselves of this indoor instruction in fundamentals will have time at Plattsburg to devote to much more interesting problems than close order drills and the manual of arms—which must be mastered thoroughly before any field progress is possible. The commanding officer of the proposed armory battalion is Capt. George Perrine, himself an engineed and a Spanish War veteran, well-known to Engineering Record readers for his article on national defense published in this journal Nov. 13. The value of the indoor work, as a preliminary to field service, cannot be overestimated. It will serve as a foundation upon which to erect a superstructure of advanced knowledge in military matters. The important thing to keep in mind is that the superstructure is impossible without a stable base. When Captain Perrine gives the command "Fall In!" next Thursday, he should face a large and enthusiastic company of engineers.

Society Progress in Minnesota

ENGINEERS generally are familiar with the co-operative work which has been done by engineering societies nationally and in certain of the large cities. It has remained for Minnesota, however, to establish co-operation among societies through a state organization. As noted briefly in the news section of this journal last week, the Minnesota sections of the American Institute of Electrical Engineers and of the American Society of Mechanical Engineers, the Northwestern Association of Members of the American Society of Civil Engineers, the Minnesota Surveyors & Engineers' Society, the Minneapolis Engineers' Club, the Civil Engineers' Society of St. Paul, and the Engineering College of the University of Minnesota have formed the Minnesota Joint Engineering Board, whose purpose is to secure co-operation on public matters of an engineering character. The matter needs only to be mentioned to bring forth hearty commendation. The organizations mentioned are to be congratulated on their step. May the Minnesota Joint Engineering Board soon have to its credit substantial achievements in the interest both of the public and of the engineering profession.

Engineer Commissioners

PERSONALITY, business sense, broad vision and a judicial temperament—all of these attributes were mentioned recently by this journal as essential for the success of the engineer as a public service commissioner. Because the engineering profession has had to fight so hard for any recognition in the selection of commissioners, there has been a tendency to regard the appointment of any engineer a great triumph. The fallacy of this view was illustrated recently by the dismal effort of a certain engineer commissioner at an important hearing. His lame and halting delivery, contrasting so sharply with the fluency of the lawyers who preceded and followed him; his substitution of personal opinions for facts from which the experienced tribunal could draw its own conclusions; his failure to differentiate between actual investment and investment indicated by inadequate accounting systems; and, above all, his lending of his technical knowledge to the support of doctrines unscientific but popular—all of these things seemed to stamp him as sadly deficient in all of the attributes mentioned above—a man to be employed by a commission for the benefit of his technical knowledge, but not to sit in judgment on the larger questions. It may be he did not do himself full justice. He was in a peculiar position, speaking as perhaps the only engineer on his side of the case in the presence of numerous engineers on the other side, and attempting to argue a technical matter before a non-technical tribunal. This may have made it seem necessary for him to appall his fellow commissioners and the court by his engineering learning, and at the same time show that learning to the critical engineers in a surer way by the abundant use of terms that none but the engineer would understand. The exhibition could hardly have been taken as a convincing argument for the appointment of engineers on commissions, and the Engineering Record hopes that those who see great advantage to both the profession and the public in the selection of engineers of the right type will support only those who possess qualifications for a commissioner's duties.

Major Bond's Military Articles

THE series of articles on "National Defense—For Engineer and Contractor," by Major P. S. Bond, Corps of Engineers, U. S. Army, which begins in this issue, states the great problem of military preparedness in engineering terms. The manuscript has been written by a regular Army officer and approved by the War Department at Washington. The facts and figures, therefore, bear the weight of authority. It is well to emphasize, at the outset, that the mere reading of these articles will not make a military engineer, but the series will form a valuable preliminary to instruction in the field. It will give a man a broad view of the country's present military status and future needs, and will show how engineers can make their specialized technical training a national asset of vast importance. With these facts in mind, the engineer may begin actual training at Plattsburg and other military camps next summer with a clear understanding of the ultimate aim of the work. To the man of narrow vision military drill appears only as irksome routine—a mere change of direction in marching when the command "Column Right" is given. To the man who can see farther there is more in it than this. It accomplishes definite disciplinary objects and is the very essence of an efficient fighting force. This is the ultimate goal—not merely precise execution of close order movements, but success in battle. No able-bodied man can consistently favor measures of adequate national defense and elect to have someone else do his fighting for him. If Major Bond's articles aid in impressing upon engineers their obligation to prepare for any eventuality that this country may face, they will have served their purpose.

Spanish for the Engineer

WITHIN the past year, this journal has urged upon its readers—especially the younger men—the advantages that would accrue to them through a knowledge of Spanish. The possibilities in the process of development in the Latin-Americas are so attractive that it does not seem amiss to refer to them again. The future of many of the men just starting their professional careers, doubtless, lies southward. While it is possible that many who do not know Spanish will find openings in the new fields, the man who has acquired a speaking knowledge of the language will be doubly prepared to realize the full value of the opportunities that are presented. Spanish is an exceedingly easy language to learn. By devoting one hour a day to a study of it the man of average intelligence should, in three to four months, be able to acquire a sufficient knowledge to enable him to carry on an every-day conversation with ease and facility, and to read newspapers and similar matter in that language without difficulty. From this point it is merely a matter of practice until Spanish is almost as familiar to him as is English. It is desirable that the studies should be made under the direction of a competent instructor, but so simple and so regular are the accents and sounds that it is possible to attain a sufficient knowledge of the subject to make oneself understood in conversation, and to acquire ease in reading, without even this advantage. The American engineer should, without delay, take up the study of Spanish. To procrastinate, or to neglect to do so, is likely to handicap him greatly if his future work is to be done in South America.

Flow of Concrete

THAT the subject of continued deformation of concrete under sustained loads is claiming increased attention is evidenced by the fact that at least three papers presented before the American Concrete Institute at its recent annual meeting contain test results demonstrating that concrete flows under sustained load. As the tests so far made are by no means exhaustive, usually being limited to but few specimens, the need for more complete investigation has already been emphasized in an editorial on page 246 of the Engineering Record of Aug. 28, 1915. On page 251 of the same issue the Minnesota test results by F. R. McMillan are given, while in last week's issue the subject was discussed in papers abstracted on pages 279 and 282. On page 329 of this issue still further evidence is offered in the paper by E. B. Smith. On of the most important deductions from these tests is the fact that field measurements of strains in reinforced-concrete structures cannot be used as indications of internal stress conditions in the manner usually adopted in applying the coefficient of elasticity to the unit strains. The effects of shrinkage and moisture contions, the unknown value of the coefficient for the various stress conditions and the direct influence of the time element all must be considered in translating strain into stress. While the magnitude of the continuing deformations under sustained load is not large, and the tendency to reach a constant limiting deformation within a given time is reassuring, these tests raise problems in design for deflection and permanence of structure which engineers should keep in mind for the future investigations which will doubtless follow.

Why State Engineering Societies?

HAS the state engineering society passed its field of usefulness? Has the diversity of civil engineering progressed so far that the engineer interested individually only in different branches such as drainage, highways and waterworks, cannot afford to spend the time to attend meetings where a few papers only are given on his particular subject? Have the associations devoted entirely to a single line of work, such as roads and pavements, usurped entirely the field of the general society? These and other questions of like nature were in the minds of engineers attending the joint meeting of the Illinois Society of Engineers and Surveyors and the Illinois section of the American Waterworks Association. Few highway officials were in attendance, presumably because many of them had spent the preceding week at the university road school. When the road papers were being read the sewage enthusiasts strolled out, and when the waterworks papers were presented the highway men became restless.

To the consulting engineer who does general work and to the city engineers who handle a multiplicity of lines the general organization appeals strongly. There seems to be a need, however, for a careful restatement of the bonds and principles which all these engineers have in common. The constitution states that the objects of practically all engineering organizations shall be the advancement of engineering knowledge and practice and the maintenance of a high professional standard. That statement, however, is too general and a small organization, to succeed, must have more closely defined common causes.

The Illinois Society of Engineers has an enviable record, has served its members well and is on a firm financial basis, having more than $1,000 in its treasury, but it is not growing materially in membership. The incoming officers can, therefore, with profit not only to the Illinois society, but to all state organizations, make examination of itself and its field. Some of the things worth while considering were voiced on the floor of the convention—greater opportunity for individual expression by the younger men and participation in civic affairs looking toward the education of the public in engineering matters. To this list might be added co-operation of existing societies to avoid duplication of effort, a study of the newer relations among existing organizations, and the tendency toward the democratization of the national societies with the spread of the section idea and what bearing this will have on the state societies. Most careful consideration should be taken of new organizations—those of the specialized type, such as drainage and highway associations, and those of the all-inclusive type, which feature the business side of engineers and engineering rather than the technical side.

Low Standards in Engineering Education

WHEN so eminent an educator as Professor Swain, of Harvard University, can make the deliberate assertion, as the result of his many years of experience, that the average college graduate knows nothing accurately, cannot think logically or observe correctly, has not gained habits of accuracy, and does not know how to obey orders, that men go through college with standards that in business would cost them their jobs, and further, that college or engineering education educates nearly all the common sense out of a man, it is surely time for those who are responsible for our educational institutions to give careful thought to their administration as well as to the courses themselves. Professor Swain's letter on page 291 of the last issue, in which he discusses the decreasing enrollment of civil engineering students, is a strong presentment in favor of the view that such a decrease may not be undesirable.

Two constructive suggestions directly affecting both teachers and administrators in the field of engineering education follow logically from Professor Swain's letter. First, low academic standards should be raised. This can be accomplished by deliberate efforts to develop those habits of logical and accurate thinking which are so conspicuous by their absence in the average college graduate through that severe discipline which Professor Swain advocates. Second, only teachers who themselves possess common sense and can develop it in others, should be allowed to teach engineering. Furthermore, teachers must be able to inspire their students to give their very best efforts to the college work, to stimulate each one to independent self-expression, and to develop in them a strong and life-long ambition to obtain the highest possible goal for which they are qualified.

It is difficult to select the favored few who can profit by the opportunities offered in higher education. Who can predict with certainty what any man may become? His will may be strongly awakened in a stimulating and helpful atmosphere, and great service to the profession be given by one who, seemingly, would never rise above mediocrity. This journal, therefore, believes that the opportunity for engineering education of the right kind should be freely offered to many candidates, but that high standards of student accomplishment, vigorously and severely enforced, should result in early elimination of that undesirable half which Professor Swain states are taking the course at a loss to themselves. Moreover, were it understood that the high standards would be maintained regardless of the mortality, poorly prepared and unadaptable candidates would soon be a small minority. The better class of students who remain can accomplish more real work and the teacher's efforts bear far greater fruit. The much-to-be desired goal of engineering degrees which guarantee quality would thus be attained.

Expensive Temporizing

SOME contractors are possessed of an incurable reluctance to pay small bills. When the job is costing more from month to month than the estimates bring in, even though a profit is in sight when the retained percentage is paid, the temptation to let such bills slide is very great. The big bills must be paid or the job may be crippled. A sudden stoppage in shipment of structural steel, for instance, would be very disastrous. But a few bags of cement, an occasional barrel of kerosene, or a few tons of coal at a delivery can be obtained from any number of dealers at any time. In other words the big bills have to be paid or the consequences may be serious. The little bills can wait—there are no consequences. The little creditor will not even sue. He would have to pay more for collection than he would receive from it.

One contractor evidently used such reasoning when, a few years ago, he purchased some materials amounting to less than $100 from a firm with which, in the preceding decade, he had done business amounting to almost a million dollars. The bill has not been paid yet, and, beyond sending out monthly reminders, which the contractor completely ignores, the manufacturer has taken no action. But, because of the magnitude of his previous purchases, the contractor is somewhat of a marked man with that firm. Even the higher officials of the company have taken cognizance of his lapse. They are beginning to doubt his honesty. In the due course of events, when construction is on the boom again, the contractor will probably send an order or ask for a quotation. It is very likely that he will be asked to establish a credit, make a cash deposit, or furnish a bond. Of course, he will have the alternative of going elsewhere for his materials, but it may be that at that particular time the manufacturer in whose bad graces he happens to be will be in a position to quote the lowest price. In any event, slowness in paying a very small bill is quite likely to prove very expensive to him in the long run.

Another case is that of a contractor who had a dispute over a small difference in a $500 account. The upshot of it was that he refused to pay any part of the bill until it was corrected to suit his opinion. The manufacturer sued and obtained a judgment against him, but the contractor had arranged his affairs so that it was not collectible. A year or so passed and the matter was almost forgotten. Then the contractor was lowest bidder on a $200,000 job at a good price in a distant city. Before awarding a contract to him the authorities looked up his antecedents. They unearthed the matter of that unsatisfied judgment. There was considerable hesitancy about awarding the contract to him, and he only got it after he had almost given up hope himself, by going to considerable expense in traveling and bringing witnesses to speak for him to the city in question. Then, too, the judgment was eventually paid.

These instances do not take into account the general class of small creditors—the coal and oil dealers, the small-town lumber dealer, owners of one or two teams and the like. They seldom get the satisfaction of future squaring-up and very seldom sue, but they talk, and scandal travels far. A contractor's reputation is a very valuable asset to him, and such talk is injurious.

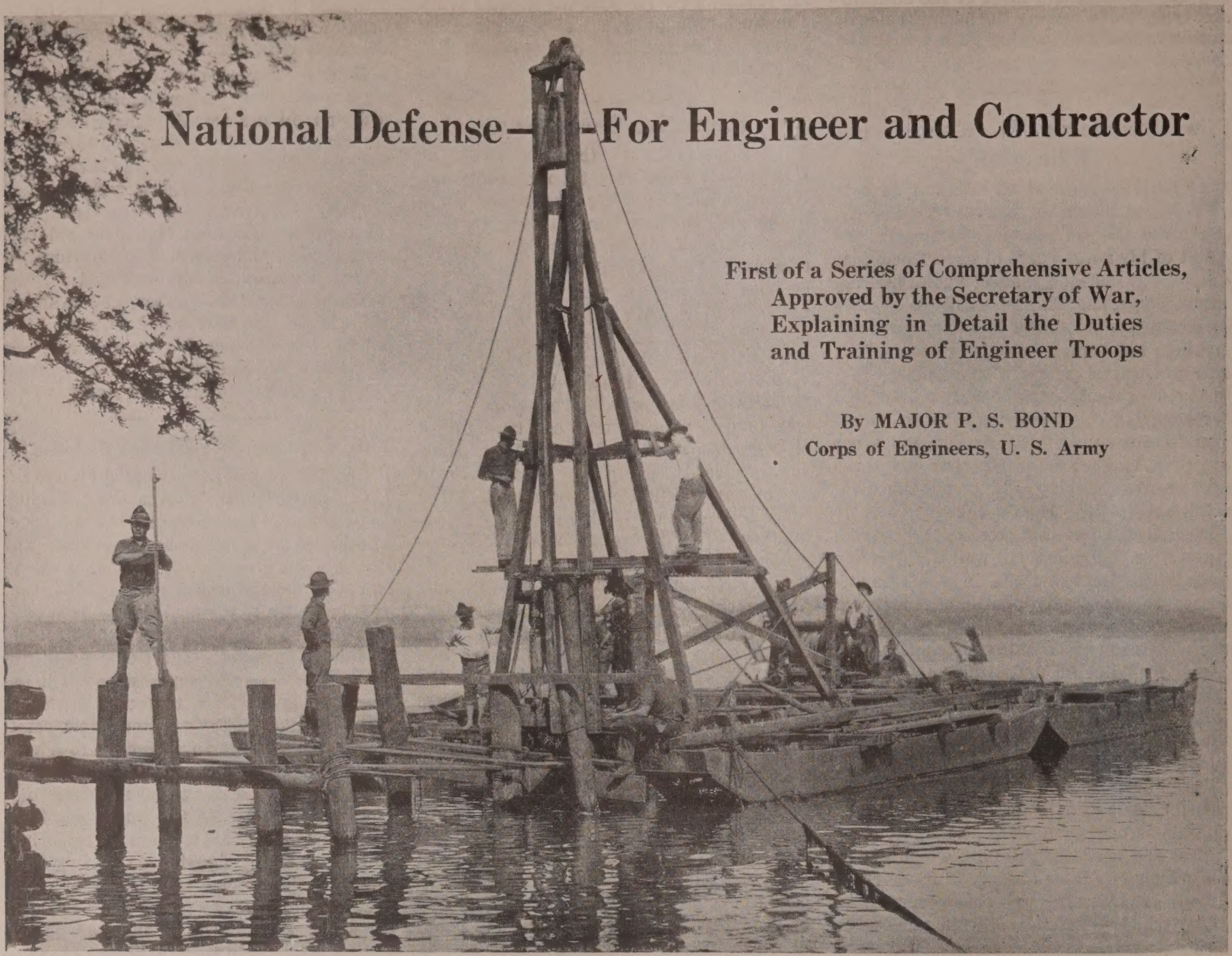
This discussion is not intended for the dishonest contractor, but for the indifferent one, not the one who never pays his bills, but the one who merely procrastinates. It would be wiser, and easier, to pay the small bills as promptly as the large ones.

The Return of Bidder's Checks

CRITICISM has been aroused on two occasions recently in the West because certified checks were returned to low bidders who failed to enter into contracts. The reason given in each case was that errors had been made in preparing the bids. That such criticism is justified this journal feels sure the great majority of responsible contractors will agree. Individual cases are apt to arouse one's sympathy, and it is unquestionable that even the best contractors make mistakes in their computations sometimes. As against these there are a very large number of irresponsible or actually dishonorable individuals who place bids merely as a feeler, to find out from others better informed what a job is worth, or how prices are going, figuring on getting their checks back on some technicality or other, even if they have to go to court to do it. Then, too, there is the ignoramus who prepares his bid from the tabulations of previous lettings of somewhat similar work, only to discover that he is all wrong on the particular job for which he is bidding.

It costs a responsible contractor an appreciable sum of money to prepare a bid for a work of average magnitude. To be sure of what he is bidding on he must make a trip over the site of the proposed work and do some very careful figuring. If an irresponsible bidder happens to confuse the whole thing, his expense has been for nothing. Also, he is placed at a disadvantage at the second letting. In preparing his first bid he figured the job would cost so much and he allowed himself a certain profit. In preparing his second bid he knows his competitors are aware of what he thinks the job is worth. To throw them off the track he must either cut into his profits or do some skillful unbalancing. The latter subterfuge being prohibited in most work nowadays, the only course left open is to be satisfied with a lower profit and a smaller allowance for contingencies. The job was spoiled for him at the first letting.

If there were no penalty attached to a failure to enter into a contract by the lowest bidder or if, in general, such a penalty should become merely a figure of speech and not be exacted, the profits of contracting would soon be a matter of history. Lettings would become mere auctioneering and no contractor could expect to survive.



National Defense—For Engineer and Contractor

First of a Series of Comprehensive Articles, Approved by the Secretary of War, Explaining in Detail the Duties and Training of Engineer Troops

By MAJOR P. S. BOND
Corps of Engineers, U. S. Army

THE principal problem confronting the nation to-day is that of preparedness for defense. There is an indication that our people are awakening, partially at least, from the sense of false security in which they had been blissfully reposing for many years. This feeling of security, which has hitherto been characteristic of the American people, is the result largely of the ultimate success that has attended our several armed conflicts. The nation has not yet experienced the chastening discipline of defeat. There is also prevalent an idea that great resources in men and materials of themselves constitute great military strength.

As to the first of these popular ideas, it is to be remarked that our successes have been unearned. We have triumphed, not because of our efficiency, but in spite of our inefficiency. The systematic and intelligent progress that has marked our industrial growth has been conspicuously lacking in our military affairs. We have never entered the lists with a powerful nation trained for the conflict and able to turn its strength against us. To this fact we have more than once owed our national existence. Our popular histories record in glowing words our successes, but they do not record the enormous and unnecessary expenditures of blood and treasure with which these successes have been purchased, nor the grave risks of national dissolution which we have incurred. For a proper appreciation of the misconception that great resources constitute great strength we have only to consider the case of China, the most populous nation on earth and possessor of vast unorganized resources, yet utterly lacking in military strength and powerless to protect herself from aggression. The military strength of a government at any instant is only the power it can bring to bear upon the field of battle.

War a Highly-Developed Science

War to-day is one of the most highly developed of the sciences—the field of the expert and the professional. This being the case there is more than at any time in the past a need of adequate preparation in advance of the outbreak of hostilities. Preparation for defense is merely a form of national life or accident insurance. When the conflagration has broken forth it is too late to organize the fire insurance company or the fire department. Fire is an unreasoning element which strikes alike the insured and uninsured. War is destruction endowed with judgment and perception—it prefers deliberately to select the uninsured.

The preparation for war is of two kinds: One of material things—the construction of battleships, submarines and coast defenses, the fabrication of weapons, munitions and supplies; the other, the organiza-

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To the engineers of New York City an opportunity of learning something regarding the need of technically trained men for National Defense has been offered by the military lecture course, organized recently by the four national engineering societies under the general direction of Major-Gen. Leonard Wood. The response to the call for enrollment exceeded all expectations. Three thousand engineers registered, and the lectures are now being given in three separate sessions each week.

Realizing that these New York meetings could be attended by only a comparatively small number of this country's engineers and that members of the profession in other states were eager for information on the subject of military engineering, the Engineering Record engaged Major P. S. Bond, Corps of Engineers, U. S. Army, and member of the American Society of Civil Engineers, to prepare the series of articles which begins in this issue.

The articles are written primarily for the engineer and the contractor—by one of the best informed officers in the army service. Their approval by the Secretary of War attests their high value.

The initial installment this week deals with the general subject of modern warfare and the relation of the engineer thereto. In succeeding issues Major Bond will discuss specific problems—stream crossings, map-making, field fortifications, road-building, sanitation, and mobilization of industrial resources.—Editor.

tion and training of the people. While both are necessary, the latter is the more important as well as the more difficult to provide.

The modern theory of war, as exemplified in the practice of the so-called military nations, is that all the resources of the state—moral, physical and intellectual—should be at the disposal of the government. War is the most critical condition of the modern state with its highly developed and peculiarly sensitive and vulnerable industrial and commercial systems. For the successful prosecution of a conflict on which the very fate of the nation may depend every ounce of its strength should be available. The aim is to strike quickly with all the force at the nation's command. That state is best prepared which can most rapidly bring to bear its resources in men and materials. In this modern theory is involved the principle that every able-bodied male citizen owes to the state the obligation of service. This principle is not incompatible with democratic ideals and is recognized in theory by our own constitution. The greater the benefits conferred by the government, the greater the resulting obligation of the citizen.

The nearest approach to perfection in the application of this theory of war is exhibited by the German Empire. Whatever may be our personal sympathies, we cannot withhold our admiration for the splendid efficiency of the German military machine and the complete mobilization of the material resources of the Empire. The history of this state shows that the military system is the mother of the German Empire. Bismarck, the statesman, planned the greater Germany, but Von Moltke, the soldier, created it when he destroyed in two short campaigns the military power of Austria and France.

GERMANY'S SYSTEM EFFECTIVE

The German system, then, may be regarded as the most effective policy of national preparation for war, and it will be of interest to consider its principal features. In the first place the training of the personnel is what is known as universal, which is to say that it is applied to a very large proportion of the male inhabitants. In the second place, it is compulsory. In the third place, it is regular. The standing army constitutes a school in which all men receive in their youth the regular training necessary to qualify them for field service, after which they are passed to the reserves and allowed to pursue the vocations of civil life, being occasionally called out for short periods of training. They thus constitute a military asset until they reach the age of physical disability, but are not withdrawn from the pursuits of civil life.

Significant Statements Made by Major Bond

War is destruction, endowed with judgment and perception; it prefers deliberately to select the uninsured.

To repel possible attacks the general staff recommends 500,000 men at the outbreak of war, 500,000 men ninety days thereafter, and 500,000 men to replace casualties.

In all, we might muster for a field army, in case of invasion, 125,000 men, many of whom would be only partially trained.

It is safe to say that no army has ever had an excess of engineer troops.

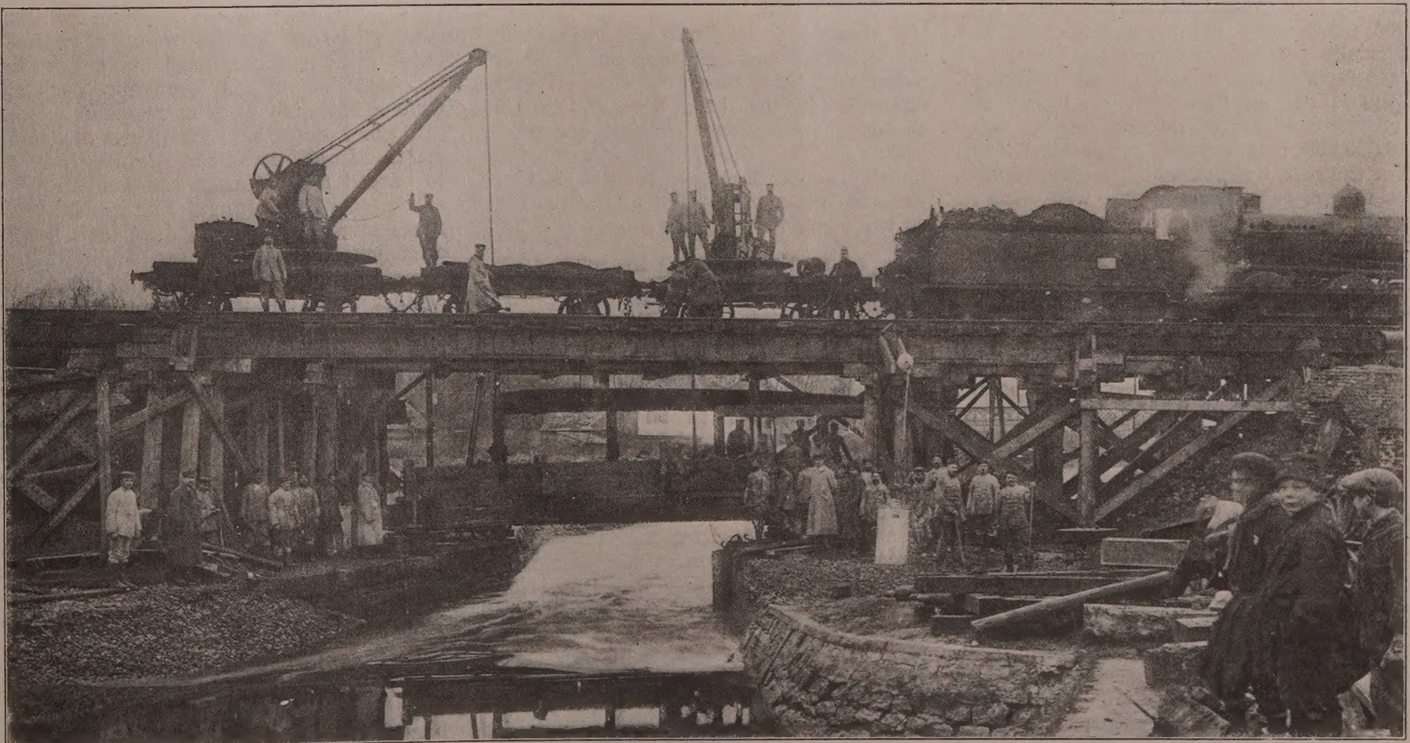
The officer of engineers must be not only a trained and disciplined soldier, but, in addition, a competent and experienced engineer.

Of the peaceful arts that contribute the results of their research and practice to the successful prosecution of war, none is of more vital importance than engineering.

Military engineering, in contrast to civil practice, is characterized by makeshifts and temporary expedients.

This excellent system of general training is supplemented and made effective by governmental control of the material resources of the country, including the transportation, agricultural and industrial systems, to the end that they may be instantly brought into efficient service in case of war. This mobilization of the resources of the country is controlled by a large corps of highly-trained officers known as the Great General Staff. Such, in brief, is the German system, which exemplifies the modern theory hereinbefore referred to, that all the resources of the state, moral, physical and intellectual, should be at the immediate disposal of the government for use in case of war. Such a system is most effectual under a highly centralized, indeed a despotic, form of government. But it is not limited to such, inasmuch as France, a republic, has adopted and carried out practically the same system as Germany. On the other hand, China, hitherto and possibly again to be one of the most despotic of governments, has no military policy whatever, unless peace at any price may be so called.

In contrast with the efficient systems of the continental powers of Europe the defects of our own military policy are most glaring. "Whether we may be willing to admit it or not," says General Upton, "in the conduct of war, we have rejected the practice of European nations and, with little variation, have thus far pursued the policy of China." It is not the purpose of the writer to dwell at length upon the defects of our system, nor to detail the mistakes that have characterized the conduct of our past wars, but to look hopefully to the future. In recent years there has been



—*Photo, Press Illus. Co.*

"MILITARY ENGINEERING IS, IN A GENERAL SENSE, THE ADAPTATION OF CIVIL ENGINEERING TO THE CONDUCT OF WAR" a marked improvement in our national defense. The regular army has been enlarged, a general staff has been established, and the system of instruction for both officers and men has been greatly extended and improved. The militia of the several states has been brought into closer relation with the federal government, and better methods of instruction have been inaugurated. We are still, however, very far below European standards. Our military policy has not kept pace with the growth of our population, the advances in the science of war, and the constantly augmented strength of other nations.

There is promise that the present agitation for national defense may result in the further strengthening and improvement of our organized forces, but the outcome is still uncertain and our discussion is based, therefore, on the policy as it exists to-day. This policy is, perhaps, the logical outcome of a firmly rooted national prejudice against large standing armies. Our form of government and the spirit of our people at present preclude that efficient form of preparation adopted by the Europeans and characterized by large standing armies and reserves and compulsory regular training. It is doubtful if anything short of a great national calamity will cause a radical change in this policy. We can and should, however, do everything possible under the restrictions imposed by the temper of our people to make the national defense effective, or rather to decrease its inefficiency, to plan for the future and avoid some of the mistakes of the past.

OUR PRESENT FORCES

Our organized land forces at present consist of a well-trained standing army of about 100,000 men, and a partially trained national guard having an enrolled strength of about 130,000 and an effective strength less than this figure. Neither organization is provided with a reserve. The demands of our oversea possessions considerably reduce the number of regular troops available for home defense. In all, we might muster for the field army in case of invasion 125,000 men, many of whom would be only partially trained—not first line troops as that term would be understood in Europe. This is not an imposing array certainly, for the greatest of nations, having some 18,000,000 men capable of bearing arms. For the rest, we should have to depend upon volunteers or conscripts, men with little or no training, who would require months to fit them even for defensive warfare against the highly trained troops of a foreign foe. In this connection it will be of interest to note that the British government has recently resorted to compulsory service and has announced the policy that hereafter no troops not having at least one year of constant training will be sent to the front. Such is the result of the bitter experience derived from opposing imperfectly trained volunteers to the highly trained German regulars. At present our chief reliance for defense is in these same imperfectly trained volunteers. The prospect is not a cheerful one nor calculated to arouse our pride and fill us with confidence.

What would be required in the event of war? This, of course, is problematical. The nations of Europe assume in advance that their entire strength may be required, and this is actually the case of several of them in the present war. A protracted struggle with a combination of foreign powers might call for several millions of men. The following table, prepared by the General Staff of the Army, shows the expeditionary forces which, in the event that our navy were defeated or bottled up, could be landed on our shores:

State	Strength of regular force	First expedition	Time, days	Second expedition	Time, days
Austria ..	4,320,000	72,000	20.7	108,000	40.4
France ..	5,000,000	161,000	15.8	243,000	30
Germany..	5,000,000	387,000	15.8	440,000	30.8
Great Britain.	695,000	170,000	14	......	27
Italy	2,600,000	91,000	18.3	136,000	35
Japan ...	2,212,000	96,000	22.5	143,000	41
Russia ...	5,000,000	38,000	20.5	66,000	40

To repel possible attacks of this nature the General Staff recommends the following:

500,000 men at the outbreak of war.
500,000 men in 90 days thereafter.
500,000 men to replace casualties.

For the purposes of our discussion then, we will assume that a volunteer army of 1,250,000 men will be required. This is a modest figure. It is to be noted that it contemplates strategical defensive measures in particular. Such a force would be totally inadequate to a foreign invasion except of a weak neighbor, such as Mexico. It would not serve to maintain the "Monroe Doctrine" in the face of determined aggression by a great foreign power, especially when the inadequacy of our water transport facilities is considered. Preparedness for defense of our own territory does not of course preclude the possibility of offensive tactical operations, and it is the blows which we strike and not those which we fend that win the victory. But it does condemn us in advance to suffer all the ruin and agony of war on our own soil in case of aggression by a great foreign power. And we should not overlook the fact that our Atlantic seaboard, the most populous, wealthy and highly developed, and hence the most vulnerable portion of our domain, might be the theater of the early stages of war. Whatever the final outcome of the conflict, the ruin and suffering in our own fair land would be very great. Germany, the greatest of the military nations, does not entertain the defensive policy of preparedness. Her theory is that an active offensive is the best defense, and her thorough preparation enabled her at the outset to carry the war into the enemies' territory and, thus far, to keep it there. Thus is Germany spared the ravages of war on her own soil.

ENGINEER TROOPS REQUIRED

Without entering into the intricacies of army organizations suffice it to assume that this force would consist of sixty-two divisions of about 20,000 men each. These would be further organized into field armies consisting of two or more divisions, say twenty in all. And finally, they would constitute four main armies, each including five field armies.

Now let us consider the engineer troops that would be required for service with this force. The proportion of engineer troops with an army in the field which experience indicates to be correct is from 1/40 to 1/16. Considering the vast extent of our territory, the generally poor condition of our roads and the inexperience of our volunteer troops, it is certain that the services of engineer troops will be urgently needed. It is safe to say that no army has ever had an excess of engineer troops. The demands upon them have invariably been greater than their capacity. Our organization contemplates one battalion of engineers with each division, and an additional battalion as auxiliary to each field army. Each of the four main armies would require as a minimum two additional battalions. Besides this there would be required engineers on the lines of communication and at the main supply depots. The number and efficiency of our railroads would operate to reduce the number of engineers required on the lines of communication, unless these were subject to attack by the enemy—a not unlikely contingency. Let us assume then the following force:

Attached to divisions...............	62 battalions
Attached to field armies.............	20 battalions
Attached to armies...................	8 battalions
On lines of communication and at depots	10 battalions
Total	100 battalions

These battalions would include, on the average, 500 men and fourteen officers each. Total, 50,000 men and 1400 officers. This gives a proportion of approximately 1/25 for the assumed force of 1,250,000 men, which is none too large. In addition to this, a considerable number of engineer officers would be required for service in the War Department and on the staffs of the generals commanding divisions and armies. In many of the divisions the senior engineer officer with the troops would act also on the staff of the commanding general. The following engineer personnel (officers) is assumed as necessary for staff duty:

On division staffs............................	24
On field army staffs..........................	32
On army staffs................................	12
On lines of communication and at depots.......	12
At the War Department (General Staff and Office of Chief of Engineers)................	20
Total	100

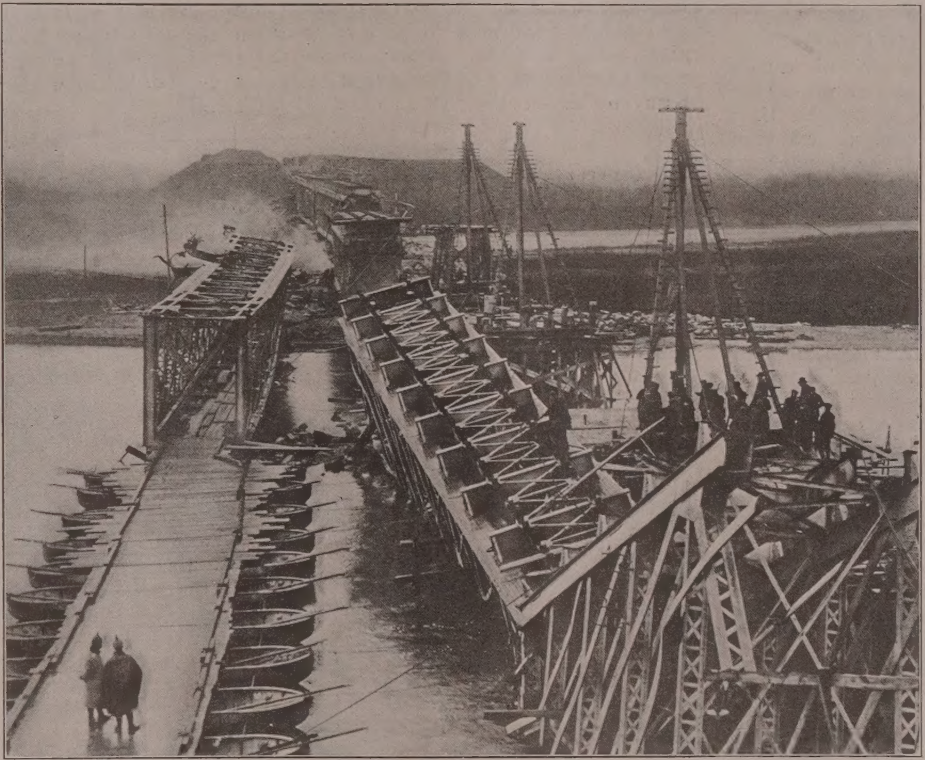
To recapitulate, say:
50,000 men.
1500 officers.

The regular army at present includes twelve companies of engineers and 248 officers. There are very few organized engineer units in the national guard. New York has two battalions of four companies each and Ohio a battalion of four companies. Certain other states have companies or detachments. In all, the guard might muster not to exceed six battalions at war strength, with eighty-four officers. The regular engineers might, with some delay and loss of efficiency, be expanded into six battalions. Thus the total available personnel of the regular army and national guard would be 6000 men and 332 officers. A very considerable number of the regular officers would be required in the training of the volunteer engineers, in the control of civilian contractors and laborers in the land defense works of our important cities and arsenals and works on the lines of communication, the direction of civilian surveyors in the preparation of military maps of the theaters of war, and many other special duties. But assuming that all were available for the tactical duties hereinbefore outlined, there remains a deficiency of 1200 officers and 44,000 men.

History has demonstrated again and again that efficient trained officers are the most important part of an army. In the hands of competent officers green troops have been known to give a good account of themselves, whereas the best troops have been uselessly sacrificed by incompetent leaders. Napoleon is credited with the statement that he would rather have an army of lambs commanded by lions than an army of lions commanded by lambs. These truths will be almost self-evident and they are especially applicable to engineer troops on account of the variety of their duties. To obtain trained officers is more difficult than to obtain trained troops, since the time and effort required to fit officers for the performance of their duties is greater than in the case of enlisted men. The officers for this engineer force are accordingly our chief concern.

An officer to command engineer troops should have the following qualifications:

It is essential that he have a good constitution, able to withstand the hardships of a campaign. He should be a man of high professional qualifications, both as a soldier and as an engineer. Without such qualifications an engineer officer cannot properly plan nor execute the varied works that will be assigned to him, nor properly subordinate his work to the needs of the combatant forces; he cannot command the respect and confidence of his own men and cannot, consequently, maintain discipline. He should be zealous in the performance of his duty—which ordinarily implies an interest in his work—resourceful, and last but not least, a student of human nature, knowing how to handle men so as to produce the best results under trying circumstances. Whence and how, under present conditions, are 1200 trained engineer officers to be obtained in the event of war?



—*Photo, Press Illus. Co.*

DYNAMITE'S DAMAGE REPLACED BY PONTON ACROSS VISTULA RIVER—TYPICAL MILITARY ENGINEERING PROBLEM WHICH THE EUROPEAN WAR PRESENTS

LARGE RESERVE NEEDED

It is essential under our present policy that we provide for a large reserve of at least partially trained men. The object of this partial training is, of course, to reduce as much as possible the time required for the final training of the volunteer army that would be assembled at the outbreak of war. The time required to train the officers will be greater than in the case of the men and accordingly special attention must be devoted to the peace training of the men on whom we must rely to furnish officers for this vast force of volunteers. The officer of engineers must be not only a trained and disciplined soldier but in addition a competent and experienced engineer. In other words, he must have training along two lines to fit him for the discharge of his duties. It is not sufficient that he be instructed merely in the technical details of his work. He must have his tactical sense so developed as to be able to grasp the situation of the moment and intelligently bend his energies to meet it with suitable works. This means that the volunteer engineer officer could not be brought to the same state of efficiency in his own lines as quickly as the volunteer infantry officer, unless he had previous training and experience in civil engineering. The volunteers taking the field should all be trained to a certain minimum standard of efficiency. Otherwise, efficient infantry would be severely handicapped by being forced to depend upon inefficient engineers. If this necessary condition is to be realized it is evident that we must obtain our volunteer engineer officers from a class of men having previous training along engineering and construction lines. The nation then, depends upon the engineering and contracting professions to furnish these men.

If our volunteer engineer officers are to be fitted to take the field on a plane of equality with volunteer officers of the other arms, special effort in the way of preliminary training will be necessary. Military engineering in a general sense is the adaptation of civil engineering to the conduct of war. It is a special application of the engineering art, and its methods and economics are essentially different from those which characterize good civil practice. It is our purpose to inquire into the relation of engineering to the conduct of war and the methods characteristic of military engineering, to the end that the civil engineers and contractors of the United States may partially prepare themselves in advance for the patriotic duty which they may be called upon to perform.

There is no science known to mankind, from astronomy to bacteriology, which does not find its application in the conduct of war. There is scarcely a practitioner or artisan who may not contribute his share to the national defense. Even the clergyman and the musician, the exponents of peace on earth and the gentlest of the arts, are called upon. Thus do we obtain a practical conception of the theory that all the intellectual resources of the nation should be at the command of the government in the prosecution of a war on which the fate of the nation may depend. Of the peaceful arts that contribute the results of their research and practice to the successful prosecution of war, none is of more vital importance than engineering.

MILITARY ENGINEER'S DUTIES

The duty of the military engineer in time of war is to plan and execute all works of an engineering nature which are required in connection with the operations of the army. It will be apparent that this is a wide field of endeavor. The engineering requirements of an army include most of those of the average large community, and in addition many others not called for by the gentle vocations of peace. The military engineer must have, therefore, a thorough working knowledge of the more important branches of civil, mechanical and electrical engineering as applied to military needs. This might appear to be more than an average man could be expected to know, and so it would be did we demand of the military engineer all the precision and nicety characteristic of civil practice. Military engineering, in rather sharp contrast to good civil practice, is characterized by makeshifts and temporary expedients. "Build for posterity," says the civil engineer. He places the foundations of his bridge at great expense of time and labor on the solid rock and he has a just pride in the enduring nature of the structure he erects. In his brain is the accumulated knowledge of centuries of painstaking construction. Long after his death the great bridge remains, a monument to his skill and devotion. How different is the case of the military engineer. Not for posterity builds he, but for the exigency of the moment. Not on the solid rock does he place his foundation, but often on the heaving bosom of the stream itself. The army arrives at the impassable stream and the engineer rapidly scans the situation. In his brain also is the accumulated knowledge of centuries of scientific warfare. Aladdin's lamp is rubbed. And lo! in the twinkling of an eye the wonderful bridge is there and the army with all its animals and heavy vehicles proceeds across. To the frail but still adequate structure are committed not only the lives of the troops, but the destinies of the nation perhaps.

The military engineer must possess not only a thorough knowledge of construction, but also a thorough knowledge of the art of warfare. He must foresee the needs of the army and build to meet those needs, and on his sagacity, energy, foresight and resourcefulness the issue of the campaign may indeed depend.

[*Next week Major Bond will explain the special duties of engineer troops and how the methods employed by the military engineer differ from those employed in civil practice.*—EDITOR.]

Does Alkali Disintegrate Concrete?

Reclamation Service Engineers Draw Preliminary Conclusions from Elaborate Experiments on Different Projects

PRELIMINARY conclusions of the disintegrating effect of alkali waters and soils on concrete obtained by the U. S. Reclamation Service engineers, are given in the February issue of the *Reclamation Record.* The general question was divided into several narrower questions, the answers to which follow.

SULPHATES MOST HARMFUL

Investigation has shown that the principal salts acting to produce disintegration are the sulphates, especially magnesium and sodium sulphates. It is thought that of these the former is the more active, but this has not been definitely established. Different localities have shown different results for the same materials.

Two extreme cases may be cited in the Sunnyside and Belle Fourche projects. Of a number of test specimens exposed on the former no disintegration was observed at the end of about eleven months with the exception of a specimen containing a soap and alum solution in the mix. The specimens were all of a 1:3:5 gravel mixture. Furthermore, none of the concrete structures on this project have been affected. On the other hand, various mixtures exposed on the Belle Fourche project were all found to be disintegrated at the end of eight months, with the exception of a 1:2 mortar specimen which was not affected. Concrete structures on this project have also been disintegrated by alkali. Other projects showed intermediate results.

Analyses of samples from the Belle Fourche project show magnesium and sodium sulphates present in strong solution, with the former predominating, and from the Sunnyside project show sodium sulphate only, and in much lighter solution. As a general proposition, it must for the present be concluded that in locations where alkali is present containing these salts, special precautions must be taken to prevent its possible action, unless experience with structures previously built has shown no deleterious effect, as in the case of the Sunnyside project above cited.

LEANER MIXTURES MORE EASILY DISINTEGRATED

It has been quite clearly demonstrated that the leaner mixtures of concrete are more easily disintegrated than the richer; also, that the more scientifically proportioned mixtures—that is, those having least voids for given proportions of cement and aggregate—give better results. This is a natural result, as the action results from seepage of water into or through the concrete, which is retarded by the richer and more scientifically proportioned concrete.

Experiments have shown that the more nearly impervious the concrete the less it is disintegrated by alkali. It is a natural deduction, therefore, that waterproof concrete will resist alkali action. Such concrete under certain conditions may be difficult to produce. Laboratory experiments have shown that it is possible to produce concrete that is practically impervious to water up to 50 to 75 lb. pressure, and satisfactory results have been obtained in the production of an impervious concrete in the field on structures where special pains were taken toward that end.

ALKALI PROOF CEMENTS

There are numerous patented waterproofing compounds on the market; there are also being manufactured several so-called alkali-proof cements. A number of these have been tested, but the results have not been any better than those obtained with straight Portland cement. Sand cements also have so far shown no superior alkali-resisting qualities. J. Y. Jewett, cement expert, gives his tentative opinion "that with good cement, with care in the selection of suitable aggregates, with proportioning to produce a rich dense mixture, and with proper methods of mixing and placing, it is possible to produce a dense impervious concrete that will withstand the alkali action under ordinary conditions without the use of any special materials for waterproofing purposes." With fairly rich concrete an impervious skin of neat cement or rich mortar, such as is produced by working a flat spade between the concrete and steel or surfaced wood forms, will no doubt also have a decided effect in resisting the action of alkali.

Unusual Methods Simplify Topographic Survey of Rough Wooded Area

Mine LaMotte Tract in Missouri Mapped on 50-Foot Scale with 2-Foot Contours for Mill and Town Site at Total Cost of $3.34 per Acre

By R. E. DAVIS and W. H. RAYNER

Instructors in Civil Engineering, University of Illinois, Urbana, Illinois

THE Mine LaMotte Company, operating lead mines at Mine LaMotte, Missouri, recently had completed a large-scale topographic survey for a proposed mill and town site, the methods of which survey were somewhat at variance with those usually employed. The tract over which the survey extended was rough and the topographic features were irregular, the maximum slope being about 35 in 100 and the maximum difference in elevation being 200 ft. in a third of a mile. The purpose of the map made it necessary that the scale should be 50 ft. = 1 in., and that contours should be shown at 2-ft. intervals, and attempt was made to maintain a precision in field work consistent with the scale.

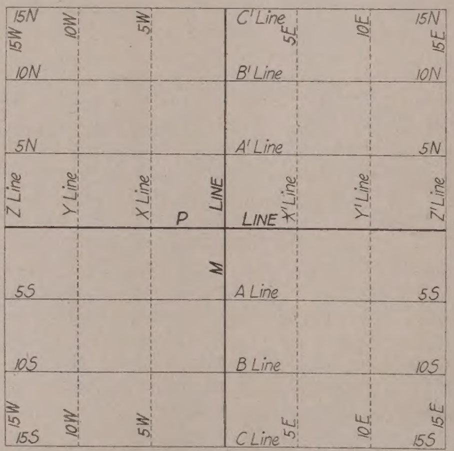


FIG. 1—HORIZONTAL CONTROL OF TRACT

USUAL METHODS

Perhaps the two more common methods on large-scale topographic surveys are (1) the "square" method, in which the tract is subdivided by lines established with transit and tape into small squares (usually 100 ft. or less on a side), the contours crossing the sides of the squares being directly located with the engineers' level, and (2) the plane-table method, in which horizontal control is provided by a large number of plane-table stations established by transit and tape traverses, the contours being directly located either by using the plane-table alidade as a level or (more commonly if the ground is uneven) by using an engineers' level in conjunction with the plane-table.

In the present case the irregularities of the land and the density of the forest growth combined to make either of the above methods impracticable on account of the excessive amount of clearing that would have been necessary; and the following method was devised:

HORIZONTAL AND VERTICAL CONTROL

Through the middle of the tract a base line *M* (Fig. 1) was run with transit and tape, stations being established every 100 ft., and hubs every 500 ft. Through the hubs, in a similar manner, laterals *P*, *A*, *B*, *C*, *A'*, *B'* and *C'* were run at right angles with the base line. Through the extremities of these laterals and at right angles with them, the lines *Z* and *Z'* were run, thus forming a series of rectangular closed traverses, the errors of closure of which could be ascertained without computations. In this way all angular and linear measurements connected with the establishing of base line and laterals were checked, the allowable error being fixed at 1/1000.

The lines *X*, *Y*, *X'* and *Y'* were run in increments of 500 ft. and made to close (errors being distributed along the lines under consideration) on the 500-ft. stations of the laterals, the maximum allowable error in distance or alignment being 1/250. Here it was unnecessary to use the transit for lining purposes except at each 500-ft. station, direction, after having once been given, being carried through to the station on the next lateral by the chainmen with flagpoles. In this way considerable less clearing was required and the transitman was able to have the transit in position for giving line along the next 500-ft. increment by the time the axemen had cleared the preceding increment. Thus the speed of the party was considerably increased.

In this way the tract was divided into 500-ft. squares, the sides of which were stationed each 100 ft. Vertical control was obtained by running profile levels over these lines in such manner as to form closed circuits, thereby checking all turning points.

LOCATION OF CONTOURS

Horizontal control was plotted at the required scale on sketch sheets of thin tracing paper, a single 500-ft. square to a sheet, and elevations of stations were recorded close to corresponding points.

The topographic party consisted of a topographer, two hand-level operators, two rodmen, two chainmen and two axemen.

The procedure of filling in the topographic details within each of the 500-ft. squares or, in other words, on each of the sketch sheets was as follows: Let Fig. 2 represent a typical sketch sheet and also a corresponding area on the ground, the numbers around the large square being station numbers and elevations. The interior lines, shown dotted, were established by chainmen with flagpoles for lining, thus subdividing each of the 500-ft. squares into twenty-five 100-ft. squares, and long blazed stakes cut from saplings as the work progressed were placed at the corners as guides for the hand-level parties. The work of clearing for these lines was light, it being necessary only to cut the thick underbrush so that a glimpse of each stake could be obtained from adjacent stakes, as will be seen later.

The order of setting the stakes was 1, 2, 3, 4, etc., referring to the numbers on Fig. 2. A trial perpendicular *A*-1 having been cleared by one axeman and chained and a stake having been set at 1, the other axeman cleared the line *B*-1. The stake at 1 was then moved to make the distance *B*-1 equal 100 ft., thus establishing a line parallel to the *A* line. One axman and the chaining party then prolonged the line *A*-1 toward *C*, setting stakes 2, 3 and 4, while the other axeman cleared the lines *D*-2, *E*-3, etc. In general the chainmen were able to run 500 ft. without being off line more than 1 or 2 ft., a negligible amount.

HAND-LEVEL WORK

Quite in parallel with the method of progression utilized by the chaining party was that employed by the hand-level parties. One party, starting from the known elevation of *A*, directly located each contour crossing the line *A*-1; while in a similar manner the other party located the contours crossing *B*-1. The elevation of 1 was thus determined by hand-level lines run in two directions. The allowable discrepancy in elevation was fixed at 0.5 ft. (on the average it did not exceed 0.2 ft.), and a mean value was chosen.

The topographer, stationed within the square *a*, plotted the contour crossings as they were obtained by the hand-level parties, and having already on the sheet the position of contours crossing the lines *A*-*G* and *B*-*G*, he sketched the contours and other details within the square.

In place of the small drawing board usually used for sketching, a shallow box mounted on a plane-table tripod was devised. The box had a hinged end so that sheets not in use might be conveniently stored flat; its size (only large enough to hold sheets) made it much more convenient in the brush than a plane-table would have been, while its being mounted like a plane-table made orientation possible and thereby greatly aided the topographer in his work of sketching the deviations of contours between located points. Owing to the roughness of the ground the topographer's position permitted much to be sketched with veracity that could not have been truly portrayed otherwise.

The topographer then moved to the square *b*, and the first hand-level party worked from 1 to 2 while the second party worked from *D* to 2; and so on, for the squares *c*, *d*, *e*, *f*, etc.

MAP

In the preparation of the map the horizontal control was first plotted on mounted paper 6 ft. square; then one at a time the sketch sheets, the backs of which had been smeared with powdered graphite, were placed in position, and the topography was traced through to the map. Since the sketch sheets were of tracing paper it was a very simple matter to place the horizontal control lines of the sheets exactly over corresponding lines on the map.

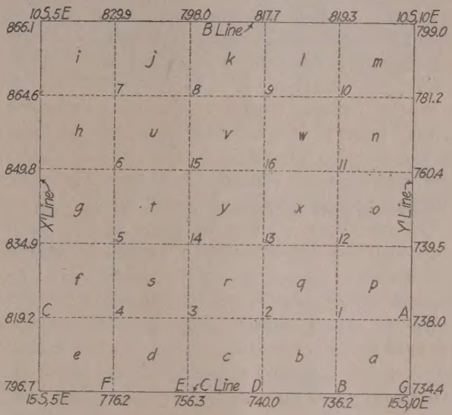


FIG. 2—SKELETON FOR 500-FOOT SQUARE

There were within the tract 8 miles of transit lines and 27¼ miles of hand-level lines. In the former case the speed of the transit party was limited by the axemen, although as many axemen were employed as could work to advantage; and owing to the rough country the speed of the level party was even less than that of the transit party. In the latter case two axemen were sufficient to clear line over which hand-levels could be operated with facility, the speed of the topographic party being governed by the hand-level parties. But while the transit party progressed on the average over only a little more than 1 mile of line per day, the topographic party was able to cover 2 miles. In an average day of 7½ hr. actual field work, approximately 650 contour points were located and plotted. The maximum area (light slope) covered during any day was 16 acres; the maximum number of contour points located (steep slope) was 810.

It is interesting to note the dependence of cost on scale or contour interval. The cost of the field work here considered was $3.14 per acre; the office work, 20 cents per acre. Later the same party made a similar survey of an adjoining tract with a scale of 400 ft. = 1 in. and 5-ft. contour intervals. The percentage of open country was slightly greater and the relief was considerably less marked and less irregular. The cost of the field work of the later survey was 33 cents per acre.

LOANS TO SETTLERS on irrigation prospects in New South Wales for the year ended June 2, 1915, aggregated $170,000.

No Cracks in Sioux City's Concrete Pavements

City Engineer Johnson Tells National Road Conference That Dense Mixture Is the All-Important Factor

NOT a single cracked section has developed in Sioux City's 1,000,000 sq. yd. of concrete pavement, some of which has been in service five years. With this statement T. H. Johnson, city engineer of the Iowa municipality, prefaced his discussion of several of the committee reports submitted Feb. 15 to 18 at the Second National Conference on Concrete Road-Building in Chicago, and published in the Engineering Record of Feb. 26, page 286. The pavement, ranging in width from 24 to 52 ft. was laid under trying climatic conditions. The foundations included all kinds of soil, and no particular attention was paid to drainage. The grades are as steep as 16 per cent, and a leaner mixture than any authority recommends was used in one course 6 in. thick, without a pound of reinforcing steel or a single metal-protected joint. Sioux City, according to Mr. Johnson, is laying practically a crackless pavement, and one that remains crackless under average conditions prevailing throughout the country.

One committee states in its report, said Mr. Johnson, that the thickness of a concrete pavement depends on nine things. What this means is that there are nine things that cause concrete pavement to crack unless it is made thick enough to prevent this occurrence. The experience at Sioux City, according to Mr. Johnson, indicates that this list includes some things that it should not, and further that there is a better way to prevent cracking than by increasing the thickness.

CLIMATIC CONDITIONS SEVERE

The climate at Sioux City is very trying upon the pavement slab. The range of temperature is from 115 deg. above (in the sun) to 35 deg. below zero. During the heat of summer there are frequent heavy rains, and very sudden extreme variations in temperature. Last July, for instance, the rainfall was 7½ in.; three storms averaged 1½ in., with a maximum difference in temperatures of 42 deg. In January of this year there occurred a precipitation of only 1¾ in. and a range of temperatures from 44 above to 28 deg. below zero. If climate affects pavements, Mr. Johnson pointed out, his should have suffered heavy damage.

As to the width of the slab affecting the thickness, Sioux City has one block of pavement 52 ft. wide. It is on a street intersecting a viaduct approach and is on a fill of 4½ ft. at one end of the block and 18 ft. at the other. The longitudinal grade is about 5½ per cent, and at one end the transverse grade is 5½ per cent, so that the surface is badly warped. Immediately before laying the pavement a fill of about 3 ft. was made at the lower corner of the block, running to nothing at the opposite and high side, and at about 100 ft. along the side from the low corner. This fill was made in one layer, and over the heaviest part two or three sections have cracked. The balance of the block is free from cracks. This pavement is only 5 in. thick; part of it was laid with gravel concrete and part with broken stone. The proportions were 1:3:5. It is four years old and is subject to heavy traffic. It is one of the approaches to the Illinois Central freight depot, and on it are located the International Harvester Company's warehouse and a six-story cracker and candy factory. Under such extraordinary conditions, with the exceptionally lean mixture and thin slab, if the thickness were a function of the width this block should be a veritable checkerboard of cracks.

There is another street 36 ft. wide, and more than ¾ mile long, without a single cracked section. This pavement is 6 in. thick and proportioned 1:2½:4.

With reference to the character of the soil on which the pavement rests, a couple of miles were laid on a low, flat creek bottom, about 15 ft. above the water. The district is poorly provided with storm sewers, and the soil is a heavy, black, retentive soil, almost a gumbo. No subdrainage is provided.

None of this pavement has cracked. The grades on many of these blocks are not over 1½ of 1 per cent.

DENSE MIX IMPORTANT

The factors that affect the cracking of concrete pavements Mr. Johnson would rearrange in the following order of importance: Workmanship, materials and proportions, subgrade, and traffic. The first two of these, workmanship and materials and proportions, might be replaced with the one word, "density." In that one word is the solution of the concrete pavement problem—density of the foundation and density of the pavement slab.

The problems of crown and grade take care of themselves very largely. Up to 4 or 5 per cent grades it is the practice in Sioux City to lay highway pavement in a flat subgrade, making the slab 8 in. thick at the center and 6 in. at the sides. When the grade exceeds the above limits, the crown is reversed, dishing the slab, making it 7 in. thick the full width. The 8-ft. earth shoulders are then crowned, throwing half the drainage into the side ditch and the other half into the center of the pavement. The soil washes very badly and it is hoped in this way to prevent gulleys forming at the edges of the pavement. Transverse joints are spaced 25 ft. apart on these roadways.

The crown of the city street with curbs is another proposition. A crown of 1/50 to 1/70 of the width is more pleasing to the eye than a flat surface, and it also helps materially in keeping the street clean, as the wind blows most of the litter into the gutters.

CONCRETE THE LEAST SLIPPERY PAVEMENT IN SIOUX CITY

Concrete, Mr. Johnson stated, is the least slippery pavement of any in his city. There are 5½ miles on 6 to 9 per cent grades, ¼ mile on 12 to 15 per cent, and ¼ mile on a 16 per cent slope. Even these steeper grades are not corrugated. These pavements are all in daily use and all kinds of traffic are said to seek the concrete streets during slippery times. The grade of a concrete pavement, in Mr. Johnson's opinion, depends no more upon climate or the character of the traffic than the grade of any other kind of pavement. Frost and ice make any kind of pavement, or even dirt roads, slippery. Concrete is smooth and offers slight tractive resistance, but it is not slick. Under wear it retains its characteristic "sandpaper" finish, giving a firm foothold to all kinds of traffic.

Warehouse to Raise Freight Within and Without

Service to and from Six Floors of Los Angeles Municipal Structure Facilitated by Hoists on Roof

CONSTRUCTION is now under way on a six-story concrete warehouse being built at Los Angeles harbor by the municipality. The structure will be 152 x 482 ft. in plan and will be served by two railroad tracks extending the full length of the interior with a loading platform between, 27 ft. wide. From this platform four elevators with capacities of 6000 lb. each, which will be spaced 120 ft. apart, will afford direct service to each of the six floors, one of these elevators being large enough to handle automobiles. Goods are to be conveyed between the warehouse and the wharves by storage battery trucks, to accommodate which ramps will be provided at each end of the loading platform so that those trucks can run directly into the building and take an elevator to any floor desired.

On the roof of the building along each side will be constructed a track on which electrically operated whip hoists can be moved along to serve any one of the eight tiers of doors which afford entry to the several floors from the outside of the building. It is planned to have three of these hoists on each side of the structure so that freight could be moved between the street and any desired floor at three points simultaneously on each side of the building. These hoists, which will have a capacity of 2500 lb., will be operated by remote control connections, connections being provided at each door on each floor. It is thought that this arrangement will afford ample capacity with the minimum of equipment, but as the traffic increases, if an additional number of hoists should be required, these could be added as desired without involving outlay other than for the hoists themselves.

Access to each floor is also afforded by stairways from the streets which run along either side of the building. Stairways to the second floor are inclosed within the structure and above the second floor are built outside the walls with entrances to the different floors through doors. To expedite the quick handling of miscellaneous freight two platform automatic dial scales are to be provided on the central loading platform. The structure is designed to be fire-resistant throughout and will have an automatic sprinkler system and complete electric light and power service.

Both the design and the construction of the structure are under the direction of S. A. Jubb, assistant harbor engineer.

Build Rapid Filters Over Pipe Gallery at Alton

Design Further Simplified at Plant of Illinois City by Operation as One of Two Filters Opposite Each Other

LIMITED space at Alton, Ill., forced the waterworks officials to place the front ends of the ten filters of their newly constructed 6,000,000-gal. plant close together over the pipe gallery, said Paul Hansen, engineer, Illinois State Water Survey, in a paper presented recently to the Illinois section of the American Waterworks Association. Between the ends of the two rows of filters for wash-water overflow sumps, and also for manholes, a small space is left whereby the pipe gallery may be reached, and through which pressure water pipes controlling the operation of the hydraulic cylinders of the filter operating valves may pass.

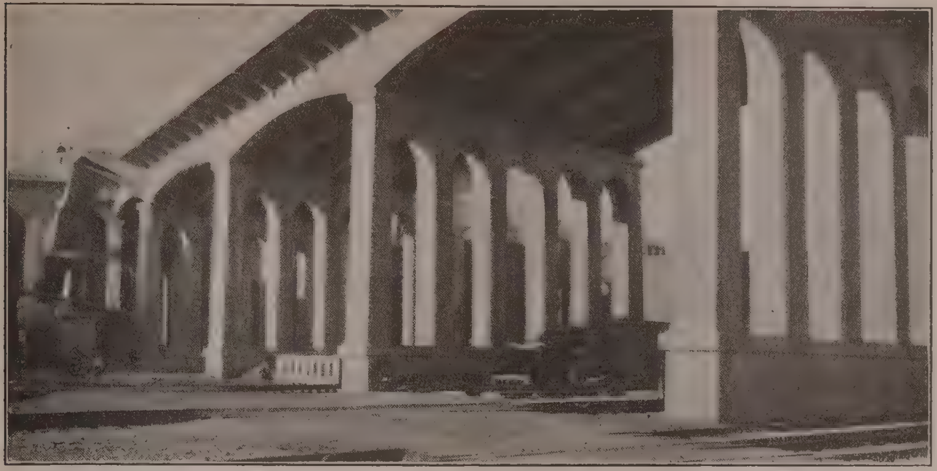
The design is further simplified by the operation of two filters opposite each other as one, yet the piping connections are such that either one may be left out of service while the other is retained in service. The arrangement is analogous to, though somewhat more flexible than, a type of mechanical filter now commonly used in the larger plants, as, for example, at Cincinnati, Columbus, Minneapolis and St. Louis, where the filter is divided into two beds by a longitudinal central gutter. In this case, however, instead of having a central gutter extending horizontally along the filter there is a sump placed between the ends of the filters.

The pipe gallery is rendered accessible for inspection and repairs by having both ends open. The peculiar design used locally somewhat crowds the cross-section of the pipe gallery, but this is a matter, said Mr. Hansen, that can be readily modified so as to leave a clear central passageway. Under ordinary conditions but one main sewer pipe would be necessary, and this could be placed at one side of the pipe gallery. The main filtered water pipe, together with its connections to the filters, may be located on the opposite side of the gallery. Under conditions locally obtaining, these modifications were deemed inadvisable on account of the arrangement of existing piping serving adjoining filters.

At the Alton plant the coagulated water is admitted for convenience at the rear end of the group of filters to one side of the pipe gallery, and arrangements are made whereby it can flow through these filters to the group of filters on the other side of the gallery. Normally, however, single or duplicate coagulated water conduits would be placed at the top of the filters and overhanging their front ends. These could be built of concrete and would not interfere with the operation of the filters.

The details are not recommended by Mr. Hansen for universal application, but they have certain advantages of economy and simplicity for plants of moderate size, especially where space must be economized. The designs and the construction were carried out under the direction of Charles T. Parker, chief engineer of the Alton Water Company.

A FILL APPARENTLY 18 FEET DEEP and actually 63 ft. deep was found on the Boston & Albany Railroad at Richmond, Mass., where the road had been built across a large swamp, in connection with the federal valuation work. The condition was described by J. C. Irwin, assistant valuation engineer of that road, in discussing before the Boston Society of Civil Engineers the paper by F. C. Shepherd, valuation engineer of the Boston & Maine Railroad, on the valuation of the Boston & Maine. This paper was abstracted in the Engineering Record of Oct. 30, 1915, page 538, and an account of the use of wash borings to determine the amount of settlement of fills in soft ground was published in the issue of June 19, 1915, page 776. In the fill at Richmond, as the bed of the swamp was peat, the limits of the sand and gravel fill could readily be determined. The settlement has continued to the present time, stated Mr. Irwin, although the road was built in 1840.

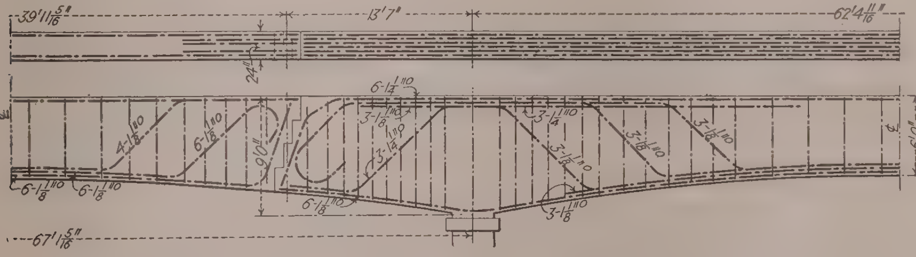


ARCHED PIERS SUPPORT SIX ROWS OF REINFORCED-CONCRETE CANTILEVER BEAMS
View of Main viaduct, showing intersection with Clark Street viaduct. Note railing and curved sidewalk brackets, both cast as separate units.

Great Variety in Design Reduces Cost of New Portland Harbor Bridge

Reinforced-Concrete and Steel Cantilever Spans Have Suspended Links and Special Details—Arched Outlines Improve Appearance

ECONOMY in design and construction, preserving at the same time an effective architectural treatment by arched outlines, is believed to have been attained by the engineers of the new Portland-South Portland viaduct across the harbor of Portland, Me., nearing completion. The total cost had to be kept within $1,000,000, and to accomplish this object unusual variety and ingenuity in detail has resulted; reinforced-concrete girders, steel girders, steel trusses and rolling lift trusses are used in the main viaduct and the various parts of the several approaches. The distinctive type adopted in both steel and reinforced concrete for the main viaduct is an arching cantilever span supporting suspended spans or links. A similar type of viaduct with cantilever construction is the Colfax-Larimer Street structure in Denver, described in the Engineering Record of Oct. 17, 1914, page 428. Marked economy resulted in each case by the adoption of this design.



REINFORCEMENT OF CANTILEVER GIRDERS AND SUSPENDED BEAMS OR LINKS

Other features which reduced the cost are the precast sidewalk brackets and railing, cast in Boston and shipped to the site, the special manhole boxes, cast on the ground and hoisted as units into place under the sidewalk, the economical design of the sidehill construction of the State Street approach, the method of casting the sidewalk slabs and the floating into position of the specially designed caissons for the harbor piers with timber framing easily removable for continuous use.

GENERAL LAYOUT AND DIMENSIONS

The new Portland bridge and viaduct replaces the old Cape Elizabeth bridge and Clark Street viaduct connecting Portland with South Portland, Me., and is being built by Cumberland County, aided by assessments on the street railway company crossing the bridge and the Portland Terminal Company below it. The viaduct is 60 ft. wide and accommodates two electric tracks with roadway and sidewalk on each side. The main part runs nearly north and south across Portland harbor and the freight yards on the Portland side. At the north end the Clark Street viaduct approach, about 40 ft. wide and 300 ft. long, on a 3 per cent grade, joins the main viaduct at right angles, and the State Street viaduct, about 700 ft. long, follows the Boston & Maine Railroad on a curving sidehill structure, joining the main viaduct nearly at right angles. Brackett Street connects with the viaduct at a slight angle.

The main viaduct is about 3000 ft. long. From Brackett Street to the water line, about 750 ft., there are thirteen reinforced-concrete alternating cantilever and suspended or link spans. The general appearance is indicated by one of the accompanying photographs. Arched outlines are used throughout, but not a single true arch occurs in the structure. Crossing the harbor on eight river piers and two piers on the south shore are seven steel cantilever and link spans of curved girder construction, with a Scherzer rolling lift span of two leaves, flanked on each side by deck trusses. The piers of the main viaduct are all skewed. On account of the skew, the lift span could not roll wholly on the piers, but when lifted the leaves are carried partly on the adjacent truss spans, which were designed to carry the added load. The south side approach consists of about 300 ft. of simple reinforced-concrete girders of small spans carried on reinforced-concrete columns on piers, and a gravel fill about 800 ft. long.

The total cost of the bridge, including land damages, engineers' and attorneys' commissions and all other expenses, will fall slightly below $1,000,000.

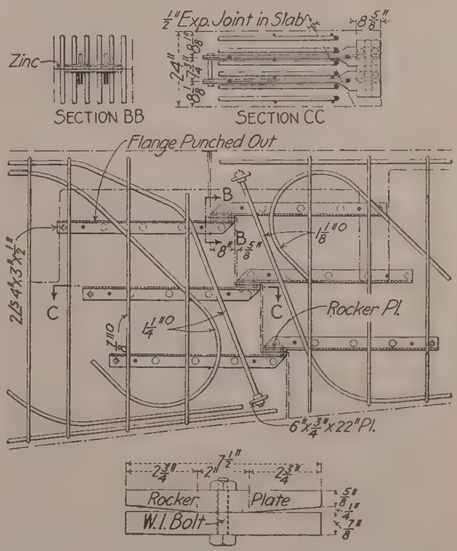
ECONOMICAL CANTILEVER DESIGN

It is estimated that a considerable saving was attained through the adoption of the cantilever and suspended span type of girder construction. The seven steel girder spans are uniformly 98 ft. long on centers, with cantilever arms of 16 ft. 4 in. on each end of the intermediate or anchor span. The thirteen concrete girder spans vary in length from about 58 to 67 ft., with the cantilever ends about 14 ft. long. It is seen, therefore, that the suspended spans are between 0.55 and 0.65 of the total span, being 65 ft. 4 in. for the steel girders, and between about 32 ft. and 40 ft. for the concrete girders.

The number of steel girders used in the width of 60 ft., as shown in the cross-section, is five, while six reinforced-concrete girders were necessary. On the steel spans two X-braces are placed near the center and one near each end between the steel girders. These are designed to distribute the loading so that all girders could be made alike. The reinforced-concrete girders rest on skew pier bents with reinforced-concrete columns immediately below the girders, but connected by arched beams giving a pleasing effect from below, as can be seen in the photograph. The steel spans are supported on steel bents resting on masonry piers. This was done for two reasons: To keep the tops of all piers at the same elevation for the sake of appearance, and as a matter of economy. An unusual detail of the floor design is the use of an 8-in. depression in the concrete floor to provide for the two tracks, carried on ties embedded in cinder concrete.

REINFORCED-CONCRETE CANTILEVERS

The details of the reinforcement in a typical cantilever beam and suspended span are shown in one of the drawings. Over the piers the reinforcing rods are bent to take diagonal tension, and ample reinforcement is supplied in the top flange. Closely

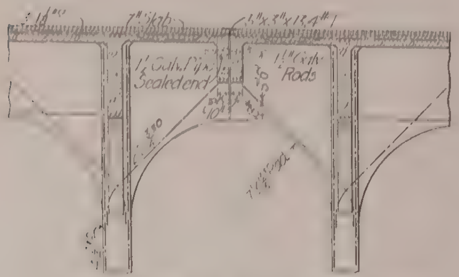


TRIPLE-SEATED JOINTS AT END OF CONCRETE CANTILEVER ARMS spaced stirrups are also used to take care of shear. These beams are seen to be 20 or 24 in. wide and 9 ft. deep at the piers, making them exceptionally large examples of this type of structure.

The connecting diaphragms are spaced about 8 or 9 ft. apart, where the cantilever brackets occur, and distribute any locally concentrated loads to the adjacent girders. The separately cast sidewalk brackets are set normal to the girders, while the connecting diaphragms follow the skew. A very unusual type of three-tier joint between the cantilever arm and the suspended link is shown in one of the detail drawings.

SPECIAL EXPANSION JOINTS

Between the main reinforced-concrete cantilever girders and the suspension girders an expansion joint is provided. The link spans are supported on three tiers of steps with rocker plates resting on bearing plates carried by four angles embedded in the concrete of each step, as shown in one of the drawings. The value of the reinforcement was developed by curving the ends of the rods or by using a washer plate and nuts, and vertical stirrups were provided. To avoid interference with the reinforcing steel, the angles have their horizontal legs punched out and the edges left rough for greater bond with the concrete.



GALVANIZED PIPE AND RODS USED IN CURVED BEAMS AT EXPANSION JOINTS

The ⅜-in. wrought-iron bolts noted between the rocker and the bearing plates were inserted for erection purposes only, and it is assumed that the first expansion movement will shear these bolts and insure free motion thereafter. A space of ½ in. was left between the vertical faces of joints to provide for expansion.

The expansion joint between the cantilever and suspended spans of the steel girder construction consists of a single seat with planed plates 1 in. thick and slotted holes for anchor bolts. Top and bottom plates are also provided, using slotted holes, as shown in the accompanying drawing. Vertical guide angles insure the alignment of the girders, and are field drilled to match the end stiffeners of the girders.

The six lines of concrete girders are carried by six-column bents or piers of reinforced concrete, with arched beam above. The reinforcement of these columns is shown in the accompanying half elevation, indicating the manner in which the column rods are curved at the top to reinforce the beams. Piles were used for the support of several bents north of the harbor line, after which a good hard gravel was encountered close enough to the surface to avoid the necessity for piling.

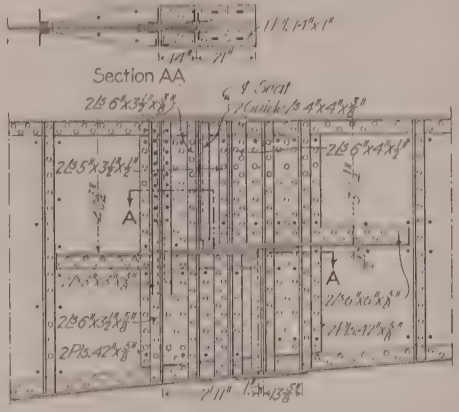
SPECIAL JOINTS AND SLAB FLOOR

The Clark Street viaduct, which is 40 ft. wide, consists of three rows of reinforced-concrete arched beams of about 16½ ft. span, carried by three-column bents on concrete piers, with arched beams transversely between them and, for the higher columns, with concrete struts at midheight. The floor, which carries no trolley rails, is a 9-in. reinforced-concrete rectangular slab about 16 x 16½ ft. between beams, reinforced in both directions. The longitudinal rods are ¾-in. round rods, placed on 9-in. centers and run straight through the bottom of the slab, with short 8-ft. rods at the top of the slab over the supporting beam. The transverse rods are also ¾-in. round ones, bent up over the center beam and spaced from 8 to 10 in. on centers. The sidewalk slabs are carried by longitudinal beams on short cantilever brackets, projecting 4 ft. beyond the center of the outside columns.

The expansion joint in the curved or arch beams is placed in the center of the panel, and contains the embedded galvanized pipe and rods for keeping the structure in line, as shown in one of the accompanying drawings.

PRECAST UNITS USED

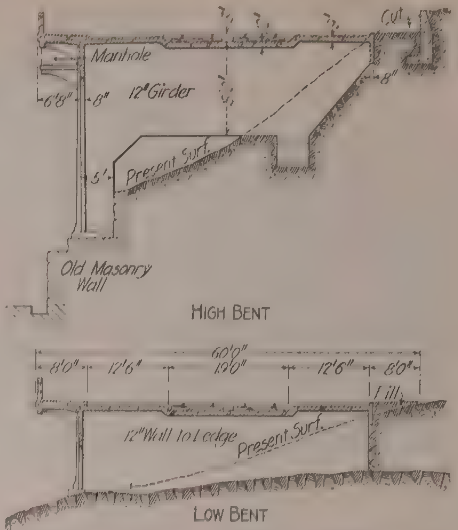
The sidewalk brackets and the rather plain type of concrete railing were cast in sand molds in Boston and shipped to the site. The reinforcement of the brackets was cast in place and protruded on the inside so that the poured concrete of the structure would furnish sufficient bond. As shown in the half-section, there are, in addition to the ¾-in. rods cast in the brackets, 1-in. rods which are cast with the sidewalk and bent down over the ends of the brackets to resist further the top flange tension. The outline of these brackets is shown by a heavy dotted line, indicating the manner in which they were incorporated in the structure.



DETAILS OF STEEL EXPANSION JOINT

In the placing of the sidewalk railing, which was cast in sections from 8 to 12 ft. long, projecting 1¼-in. dowel rods were cast in the outside sidewalk beam, and 2-in. holes in the sidewalk railings were cored out in casting to correspond with the location of the dowels. Grout was poured through the holes from the outside until flush with the surface. The posts were cast in place between the sections. The cost of this railing was only about $2 per linear foot, instead of probably $5 for the usual cast-in-place construction.

The sand molds were made by templates in ordinary molder's sand, and the railing and brackets mixed of 1:2:4 concrete with coarse aggregate not exceeding ¾ in. in size. The manhole boxes, which can be seen in one of the photographs, were cast as separate units in special forms, and were hoisted into place under the sidewalk.



ECONOMY SOUGHT BY SPECIAL SIDEHILL CONSTRUCTION—STATE STREET VIADUCT

ECONOMY IN SIDEHILL CONSTRUCTION

The State Street viaduct is sidehill construction on a curve, and follows the old retaining wall on the downhill side, as shown in the photograph and drawing. It

STATE STREET VIADUCT ON CURVE ABOVE OLD MASONRY RETAINING WALL
Note special sidehill construction, and, in foreground, locomotive crane used at Portland end of bridge. Special manholes below sidewalk were precast and hoisted into place.

was planned to use the stone retaining wall as a support for the new columns on the downhill side, but when construction was started it was found necessary to tear out the masonry and use concrete in many instances.

Another source of economy in this part of the work was the special form of girder or cross-wall design used for the supporting bents, as indicated in the accompanying drawing. The uphill side of the bent rests on a footing carried only deep enough to reach good bearing, and the downhill side is extended to the requisite depth either on or in the old retaining wall. The inside sidewalk is either cut out of the sidehill, in which case a retaining wall is necessary, or rests upon a fill, as shown.

River Pier Bases Floated to Place

The contractors for the river piers decided that it would be economical to place seven of them by the use of floating caissons, although the engineers had agreed to allow the placing of the concrete through the 20 to 50 ft. of water, provided this was done inside of sheathing and by a method which would insure concrete of good quality. Timber piles were specified, and were driven on the dredged pier sites on about 2½ to 3-ft. centers to specified resistance, and accurately cut to length by means of a circular saw between pile-driver leads. The erection on ways, the launching, and the floating of the caissons to a bearing on the tops of these piles are some of the most unique features of the construction.

TRUSS CENTERING USED FOR GIRDERS

The accompanying photograph shows the concrete base of the pier or caisson on the ways, where it was cast on a 3-in. timber platform in position for launching. This base is 4 ft. 6 in. high, with division walls 12 in. thick. In the projecting sill at the bottom are cast 1-in. hook bolts, to which long rods are attached when the timber form is built up around this base to a height of about 18 ft. The form is tightly sheathed on the outside, and calked to prevent leakage while floating.

Launching the Caisson

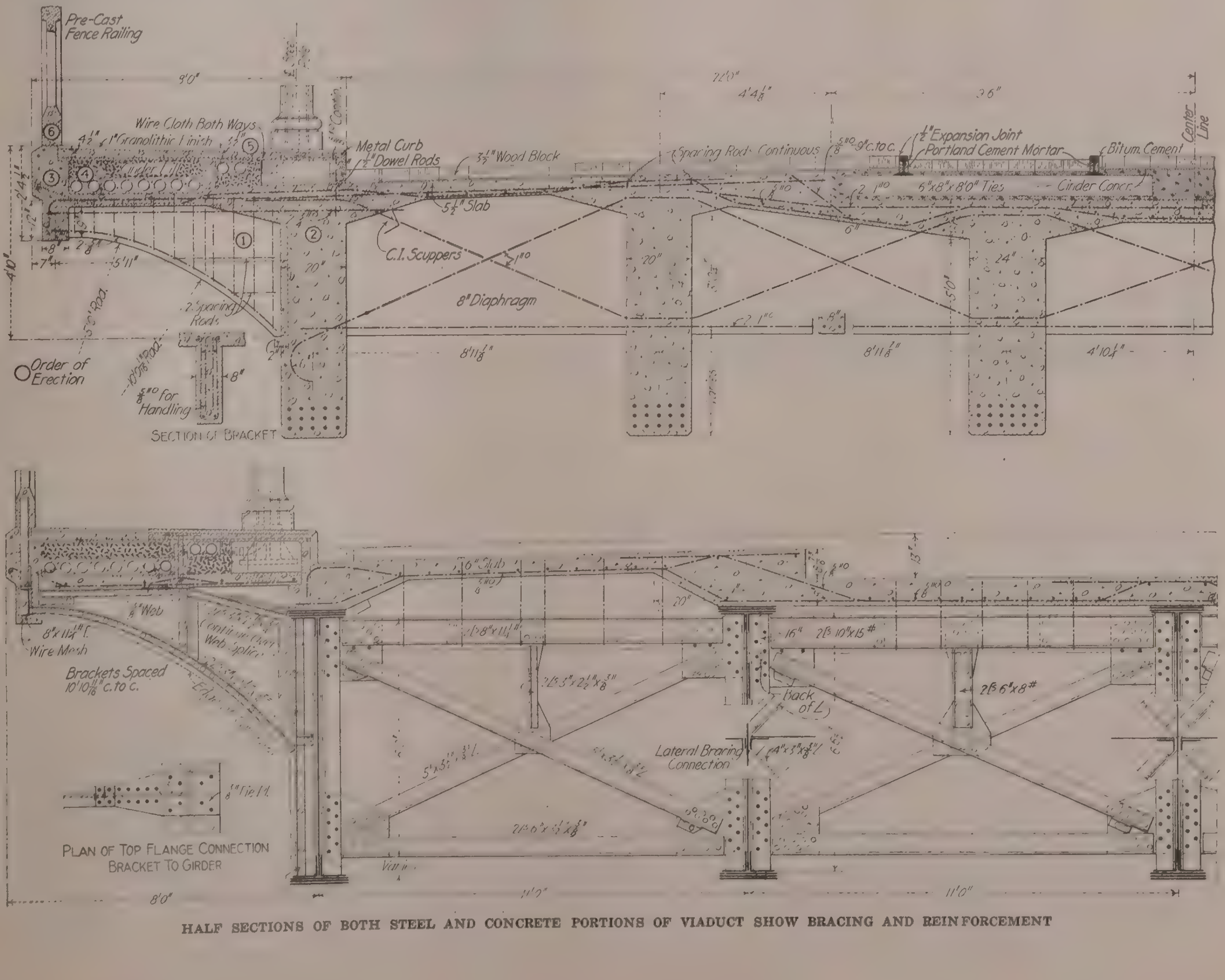
After the caisson was completed on the ways, the wedges were struck and it was launched. It was then towed to its position over the pile bed. After being secured in position, the pouring of the concrete was begun and continued until such time as the caisson rested on the piles at low tide. Additional siding for the caisson was set in place as it was sunk by the weight of concrete, the maximum depth of these sides being 53 ft. As soon as the caisson rested on the piles water was admitted in order to settle it on a firm bearing, this water entering through openings provided in the sides, and filling the space between the sides of the pier and the sides of the caisson.

Pouring of the concrete in the pier was continued in the dry, protected by the sheathing, up to a level 2 ft. below low water. Ashlar masonry was then laid around the pier, behind which the concrete was poured. As soon as the construction advanced above the water level, the outside frame and sheathing were removed by loosening the long bolts at the top and the frame was towed to the ways for use on the next pier.

The masonry facing was made 25½ ft. high and was used to prevent disintegration due to the action of sea water on concrete, especially at levels between tides in freezing climate. An attempt was made to refill the dredged part under the bottom of the piers by pouring sand around the outside, with the expectation that it would drift in beneath the pier. Finally, riprap was placed on the refilled area around the outside of all the piers for a distance of about 15 ft.

Progress in Construction

It was necessary to construct the new viaduct without interrupting the heavy traffic on the old bridge, which occupies practically the same site for much of the distance across the harbor. A temporary



HALF SECTIONS OF BOTH STEEL AND CONCRETE PORTIONS OF VIADUCT SHOW BRACING AND REINFORCEMENT bridge in the shape of a V was constructed, of a length sufficient to divert traffic from the interfering portion of the old viaduct, and this was carried to the east far enough to clear the swing bridge. A temporary draw span was provided, carried on a pile pier at the center.

The construction was begun about Dec. 1, 1914, and it is estimated that it will be completed about June 1, 1916. Up to Dec. 1, 1915, 28,400 yd. of concrete, 1930 tons of structural steel, and 700 tons of reinforcing steel had been placed. The work progressed rapidly from two main concreting towers on the Portland side, using chutes, and by the use of the derrick-and-bucket method on the South Portland side. A locomotive crane of standard gage was very useful on the freight-yard tracks in handling forms, falsework and reinforcing steel. The wooden trussed type of centering used for the concrete girders can be seen in one of the photographs.

The method of pouring the sidewalk slabs and curbs was unique in the use of a double slab, with the conduits covered with cinder fill as a form for the upper slab, while wooden forms were used along the curb against which the concrete could be poured. The work has progressed so satisfactorily, mainly by reason of the complete equipment of the contractors, together with favorable weather conditions, that it is estimated to be about three months ahead of contract time.

The bridge was designed by J. R. Worcester & Company, consulting engineers, of Boston, under the direction of J. R. Worcester and G. H. Brazer, and the construction was under the supervision of E. E. Pettee, also a member of the above firm. The work was divided into three contracts. Contract A comprises the building of the temporary bridge, the filled portion at the southerly end of the structure, the substructure for the reinforced-concrete structure immediately south of the South Portland Harbor Commissioners' line, the piers in the harbor and the substructure of section 4, which is the part lying between the Portland shore and Commercial Street. This contract was awarded to the Holbrook, Cabot & Rollins Corporation, of Boston, who in turn sublet the substructure for the reinforced-concrete portion on the southerly end and the substructure on the Portland shore to T. Stuart & Sons, of Newton, Mass.

Contract B included the furnishing of all steel spans across the harbor, including the double-leaf Scherzer draw and operating machinery. This contract was carried out by the Phoenix Bridge Company, of Phoenixville, Pa. Contract C included the superstructure across the Portland Terminal tracks, the State Street and Clark Street viaducts, the reinforced-concrete floor slab on all steel spans, the reinforced-concrete superstructure at the southerly end of the bridge, and the paving of the entire length of the roadway. This contract was awarded to T. Stuart & Sons.

→ LAUNCHING TIMBER CAISSONS BUILT UPON CONCRETE BASE, PORTLAND, MAINE

← CONCRETE BASE OF RIVER PIER CAST ON WAYS FOR PORTLAND HARBOR BRIDGE

To Increase the Usefulness of Local Societies

Plans to Enlarge Membership and Extend Influence of San Francisco Branch of American Society Proposed by H. L. Haehl

PLANS for promoting the growth and increasing the usefulness of a branch association of the American Society of Civil Engineers were recently presented to the San Francisco association by H. L. Haehl in such a form that it was at once voted to have the address printed and copies sent to all members of the parent organization residing within the thirteenth district. Extracts from the address follow:

MEANS OF INCREASING MEMBERSHIP

In order to secure for the local association a membership truly representative of the district, and at the same time distribute the dues fairly, members living more than 50 miles from San Francisco, and all juniors, should be subject to a lower rate of dues than resident members. There should be advantages to offer non-resident members, and three means of accomplishing are suggested. First, authorize the secretary to employ a shorthand reporter for the meetings, and from his notes prepare and send out for each meeting a brief of proceedings sufficiently comprehensive to give a good idea of the papers presented, the discussion thereon and the business transacted. Second, arrange more often to secure papers from non-resident members. They are very often engaged on work of great interest which is different in nature from the problems confronting those closer home, and their active interest in association affairs helps materially in unifying the organization. Third, an election of officers of the local association by letter ballot would do much to interest non-residents and promote the feeling that the organization is truly representative and that all have an equal voice in affairs.

The close association of the young engineer with older members of the society makes for his broader appreciation of the elements of high professional standing and tends to bring him to the enthusiasm that comes from being one of a body of engineers working with a purpose and toward an ideal, rather than merely an individual striving for his bread. It is highly desirable, therefore, that the junior be brought into the branch association. The objections that the tone of the organization might be lowered are groundless, particularly because of the disproportionately small number of juniors.

Larger membership is merely an end to greater usefulness, and although attention to this element comes first, other considerations are of equal importance. The engineer is not an advertiser; he takes the task that is given him and seldom fails to accomplish it, but he does not rise up in his community to announce the fact, or even subtly direct public attention to his performances. We are mostly a modest lot and we believe most kinds of advertising to be unprofessional. But there are permissible kinds of advertising which will stimulate our growth as a profession—things which we can do as a body which we would hesitate to do as individuals. Such things our association should undertake, being careful always of the dignity and standing of our profession, but mindful of our duty as citizens. Some examples come to mind. The President of the United States has only recently asked the engineering profession to assist the government in bringing about economic preparedness. We will be able, as an association, to be of great assistance. Our efforts will be strictly patriotic and not in any sense selfish, yet they will at the same time help to let the world know what an engineer is capable of doing and give him entirely proper and legitimate advertising.

Opportunities are constantly arising for engineers to take part in affairs of the city, state or nation, to the advantage of all concerned, but a permanent committee charged with securing the maximum of such useful work is a necessity. Unless organized effort is made to place the direction of these matters in definite hands, no really material results can be expected.

The engineer must be mindful that professional jealousy is common to all professions, and one of the benefits of an association is that as we increase the number of our friends in the profession our tendencies toward criticism decrease proportionately. It is to be remembered that denunciations and unkind criticisms, which are all too frequent, often prove groundless and ultimately sources of regret.

We would prosper more and would more quickly reach the point where the importance and dignity of our work would be better understood and appreciated if we were more careful in this regard. Engineers are almost invariably honest—the American engineer particularly is so esteemed by the whole world. Let us not be the first to question it. Differences of opinion and differences in method are natural, and our mistakes are usually honest ones, if we would only recognize these facts and bear them constantly in mind. A common cause promotes acquaintance and respect and tolerance. If we can make common cause in this association not only for the advancement of engineering knowledge but also for the promotion of good fellowship, we shall do much to attain the objects which are set down in our constitution as "the maintenance of high professional standing and the furtherance of the general welfare of the American Society of Civil Engineers."

Panel Testing Furnace Is of Exceptional Size

J. E. Latta Describes Design and Operation of Large Furnace Recently Completed for Underwriters' Laboratory

THE LARGEST UNIT of its kind yet completed, embodying some special features believed to be new and distinctive, is described by J. E. Latta in the January *Quarterly* of the National Fire Protection Association. The furnace has been installed at the Chicago plant of the Underwriters' Laboratory.

Dimensions of Furnace

The furnace proper consists of a shallow combustion chamber approximately 16 in. deep, 12 ft. wide and 14 ft. 9 in. high. Communicating with it at the bottom is a pit 19 in. wide and 36 in. deep. The combustion chamber, wherein the fire is maintained against one side of the sample under test, is inclosed at the back and one end by substantial stationary brick walls. Movable walls in steel frames make up the front and other end of the inclosure. The front movable wall is suspended from an overhead steel beam by trolleys, and the movable end wall is carried by flanged wheels which run upon rails within the floor.

The products to be tested may be such that the necessary testing sample will form the entire front wall of the furnace, filling completely the steel frame for this wall and subjecting the frame and the supporting trolley to great weight; or, the appliance under test may be light and may require but a comparatively small space in the combustion chamber, as is the case with wired-glass windows and the smaller fire shutters.

Four panel frames are supplied with the new furnace, the largest and strongest of which will accommodate test samples weighing as much as 24,000 lb. The frame itself for this particular panel weighs about 14,000 lb. The top of the furnace consists of heavy fire-clay blocks, and has six vents which lead to a stack. Dampers made of suitable fire-resisting materials are installed in the vents.

Observation Windows

Each end wall of the furnace has three observation windows glazed with mica, and so arranged that all parts of the combustion chamber and the exposed side of the test sample may be readily observed. An observation gallery affords access to the upper windows and the valves at the top of the rear of the furnace.

The heat supply is provided by means of six 4-in. blast burners installed in the base of the back wall of the combustion chamber, the arrangement being such that the discharge is upward at a small angle, and each of these six burners carries a screen of special design to prevent flashing back. Fuel consisting of a mixture of gas and air is conveyed to the burners through mixing tubes of suitable design. The secondary air supply consists of fifty air inlets spaced uniformly over the back wall of the furnace. Gas is supplied to the furnace through a 6-in. pipe connected directly to the street main. The air supply is from a blower system capable of furnishing something over 2000 cu. ft. per minute at a pressure corresponding to a head of 13.8 in. of water.

Temperature Measurements

Thermo-couples are employed for measuring the high temperatures within the gas furnace and on the exposed side of the material under test, the number and position of these depending largely upon the size and nature of the test sample. On the unexposed side of the test sample the temperatures are taken by means of thermocouples, and by mercury thermometers hung in various positions. Fire pressures within the furnace are indicated by means of a draft gage connected to the combustion chamber by piping. The equipment also includes provision for the measurement and control of the pressure in the air supply.

Fire Stream Apparatus

The apparatus employed in the fire stream test consists of special hydrants located at convenient points, flexible nozzles attached to the hydrants, gate valves for controlling the stream, and pressure gages at the bases of the nozzles. The tip of the nozzle is held 20 ft. from the sample when the wall is pulled from the test furnace. The hydrants are connected to the water mains under the floor, the source of water supply in which may either be three 4500-gal. presure tanks, or an electrically driven fire pump having a capacity of 500 gal. per minute. The tanks and pumps are located in an adjacent building.

AN UNUSUALLY LARGE FLOATING DRYDOCK is being built by the Union Iron Works at Hunter's Point on San Francisco Bay, as a necessary adjunct to the work entailed by the large shipbuilding contracts undertaken during the past few months. The capacity of the dock will be 7500 tons, its function being to accommodate vessels of less than this tonnage without interfering with the work on the larger dock and marine ways. The new dock, which will be equipped with electrically driven centrifugal pumps, will be 450 ft. long, 100 ft. wide and 30 ft. deep, sheathed outside with copper.

Propose to Improve the Sacramento River

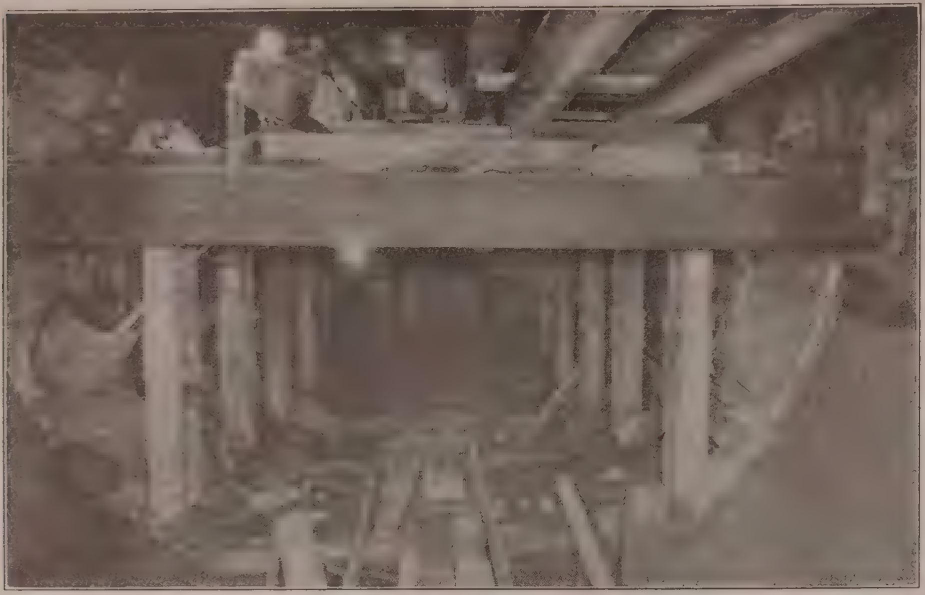
Overflow Weirs and By-Pass Channel Contemplated to Facilitate Navigation on River of Heaviest Run-Off in Country

FLOOD-CONTROL, irrigation and navigation problems of the Sacramento River in California, which have been the subject of study for many years, were reviewed by V. S. McClatchey, president of the State Reclamation Board of California, in a paper presented at the recent annual meeting of the National Drainage Congress. In referring to the plan of development now contemplated Mr. McClatchey pointed out that the Sacramento River in flood volume is the fourth greatest river in the United States, and in flood volume, compared to drainage area, is more than five times as great as that of any other river in this country. The project involves an estimated cost of about $42,000,000, of which sum the nation will pay $6,250,000, the State of California will pay a similar sum and the balance will be paid by the landowners benefited.

The work contemplated consists of the construction of strong river-bank levees which will confine in the river channel all the water it can safely carry. The excess will be taken out by means of four weirs and conducted through by-passes which empty into the river again 15 miles above its mouth, at which point the channel will be enlarged and all of the flood waters will be carried into the upper arm of San Francisco Bay. The enlarging of the channel and the construction of weirs will be under the direction of federal engineers, the expense to be equally divided between state and nation. The State Reclamation Board, working in co-operation with federal and state engineers, will have control of the remaining part, which consists of 502 miles of river levees, 180 miles of by-pass levees and the securing of by-pass rights-of-way through 85,000 acres.

The completion of this project means, Mr. McClatchey affirms, the restoration of navigability on the Sacramento River, and the preservation thereof in 263 miles of waterway; the protection of navigation on the San Joaquin River (the two rivers having a common delta); the protection of lives and property in the two valleys, including the cities of Sacramento and Stockton; the protection of reclamation, complete or in progress, on 750,000 acres of river lands whose annual production exceeds $30,000,000 in value; and the reclamation of 750,000 acres of waste lands which would add $120,000,000 to the wealth of the state, and whose annual production would be approximately $30,000,000. The growth of the state in commerce, wealth and population depends, it is asserted, to a great extent on the development of the extensive agricultural areas in the Sacramento and San Joaquin valleys, as well as upon a system of inland waterways to joint these rivers.

A PLAN FOR SYSTEMATICALLY PATROLLING HIGHWAYS has recently been put into effect in southern California by the State Highway Commission, whereby minor repair work is constantly under way during the storm season on hundreds of miles of roads. The methods adopted consist of dividing the roads into districts with a foreman in charge of each, and using light trucks to carry men and tools to and from their work.



RIBS OF FORMS CARRY LOAD AS NEEDLE BEAM IS ADVANCED TILL CONCRETE SETS

Needle-Beam Heading Method Applied to Sewer Tunnel in Dry Ground

Increased Pressure in Open Tunnel Causes Important Modifications on Brooklyn Sewer Work of Methods Used for Passaic Sewer in Newark

THE NEEDLE-BEAM heading method, using pressed-steel lining plates and radial shoring jacks to support the earth, is being applied successfully to a section of large open sewer tunnel under Tompkins Avenue in Brooklyn, N. Y. Except for the fact that the absence of water makes the use of compressed air unnecessary, and the resulting increase in soil pressure has caused the adoption of important modifications, the method is similar to that used on the Newark (N. J.) section of the Passaic sewer tunnel, and described in the Engineering Record of Jan. 30, 1915, page 130. In addition to a monthly progress of 100 ft. in each heading, the Litchfield Construction Company, contractor for this section, has lowered the cost of the work still further by equipping a screening plant at each of the two constructing shafts and using for the lining concrete the sand and gravel taken from the headings. This concrete lining is being placed rapidly by the pneumatic process.

NATURE OF CONSTRUCTION

This section of the Tompkins Avenue relief sewer, designed by the Sewer Department for carrying the increasing stormwater flow from the downtown section of Brooklyn, extends from Greene Avenue to Fulton Street and under Fulton Street a short block from Tompkins Avenue to Brooklyn Avenue. One shaft is located at Macon Street, two blocks from Fulton Street, and another at Monroe Street, three blocks from the upper end of the work. For 800 ft. the sewer has an inside diameter of 10 ft. 6 in., and for the remaining 2700 ft. is 13 ft. 6 in. inside and 16 ft. 4 in. outside diameter. It is being driven with from 30 to 35 ft. of cover, and its roof for quite a distance is but 10 ft. below an old brick sewer. Some safe method of holding the sand and gravel soil which would at the same time allow rapid progress was necessary.

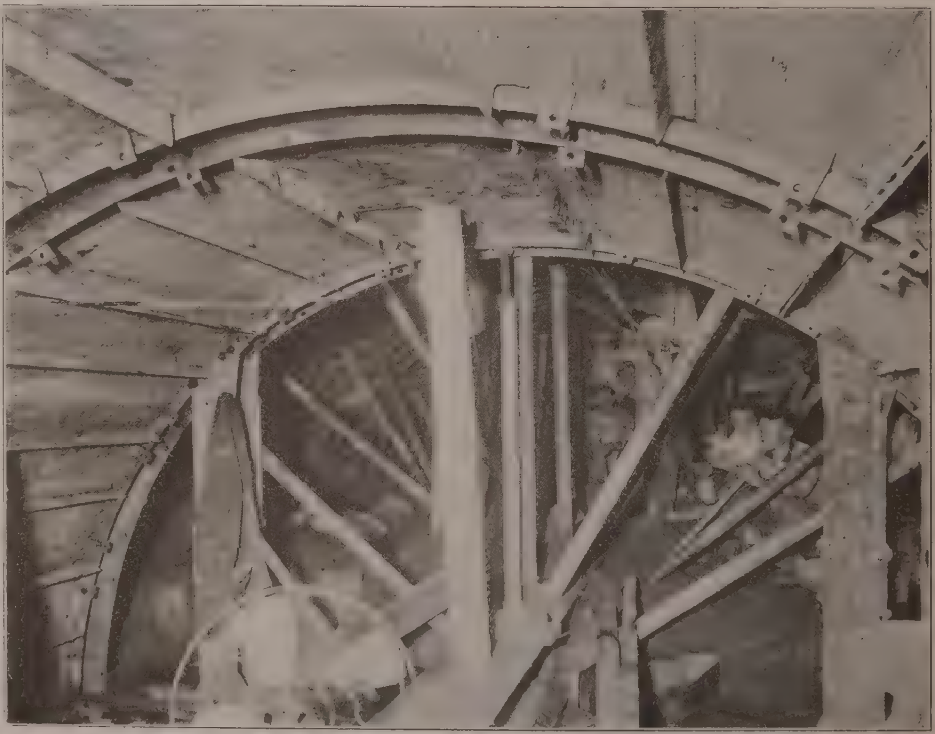
The needle-beam heading method, as developed for this tunnel, is well shown in the accompanying photographs. The needle beam is made of two 15-in. I-beams bolted together with timber separators. Instead of carrying it below the center of the tunnel and taking out most of the dirt in the top heading, as was done in the Passaic sewer, the Tompkins Avenue headings are driven with the needle beams above the center. This balances the work better, as the top heading requires more time to brace, it alone being lined with plates, and a greater pressure existing on the breasting boards at the face than on those at the end of the bench. More dirt can be taken out of a given length of bench in the same time for this reason than from the same length of heading. The plan of throwing the bulk of the excavation in the bench also reduces the length of the shoring jacks needed under the roof, where the greatest load is carried.

As in the Passaic sewer, the front end of the needle beam is carried on blocking on top of the bench, and its rear end on a 12 x 12-in. post to the concrete invert. In addition, however, two horizontal braces from the rear end of the beam to notches in the sides of the sewer and a jack from the rear end of the beam to the roof are needed. But for these, the earth pressure on the breasting boards at the face, which is carried jointly by the edge of the lining plates and the needle beam, would force the latter back, unseat the shoring jacks and let down the headings.

PILOT PLATES DEVELOPED

Another feature of the construction necessary without compressed-air support is three structural-steel pilot plates, a little wider than a lining ring, which are carried over the lining at the crown of the arch and pried forward with bars. Beneath them the top of the heading is dug out and the first lining plates are inserted. The rest of the heading is handled with breasting boards of 2-in. plank.

Nine feet of heading is excavated and lined with plates, carrying the shoring jacks on blocking in the heading. Meanwhile forms are set and the 9-ft. ring at the back end of the needle beam is concreted. Through the forms is then taken out the muck from the next 9-ft. section of bench, after which the needle beam is advanced and the jacks are transferred to it. The needle beams thus usually support 9 ft. and never more than 18 ft. of roof at once. They are about 25 ft. long. In excavating below the center of the sewer, wood lagging laid horizontally is sufficient to hold the sides, and the invert stands without support for the short time until the section can be concreted. It is necessary, how-

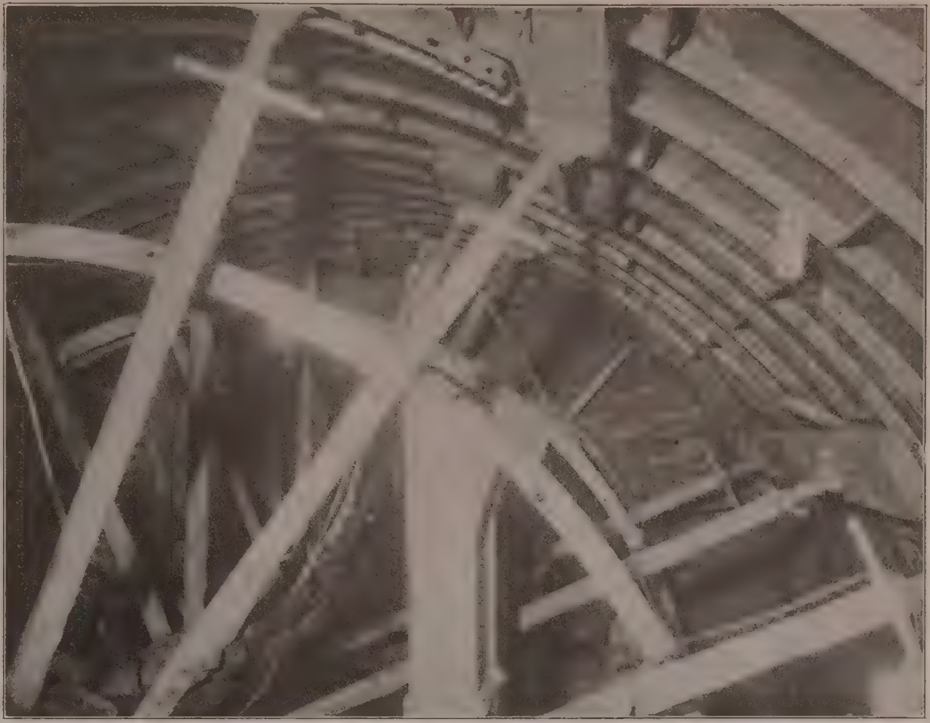


HEAVY SOIL PRESSURE REQUIRES FOREST OF JACKS AND LARGE NEEDLE BEAMS ever, to bulkhead the back end of the bench to retain a solid bearing for the forward end of the needle beam.

PIPE SEPARATORS BETWEEN FORMS AND LINING PLATES

The support of the lining plates during concreting is more difficult than on the Passaic sewer, as the green concrete cannot be depended on without air support to take the full load. Also, the strain on the form ribs is much heavier. Instead of the shoring jacks being taken out and the form plates being placed as the concrete rises, therefore, pipe separators bearing on the form ribs are used at frequent intervals to brace the lining plates. This allows all the removable form plates to be set at once. The separators remain in place, and are plugged with mortar after removing the forms. The form ribs have to be made of extra heavy channels with very deep flanges. The forms are supported by H-frames, the crossbar of which is under the needle beam and the vertical legs of which are unbolted and re-assembled at each move.

PNEUMATIC PLACING METHOD RAPID

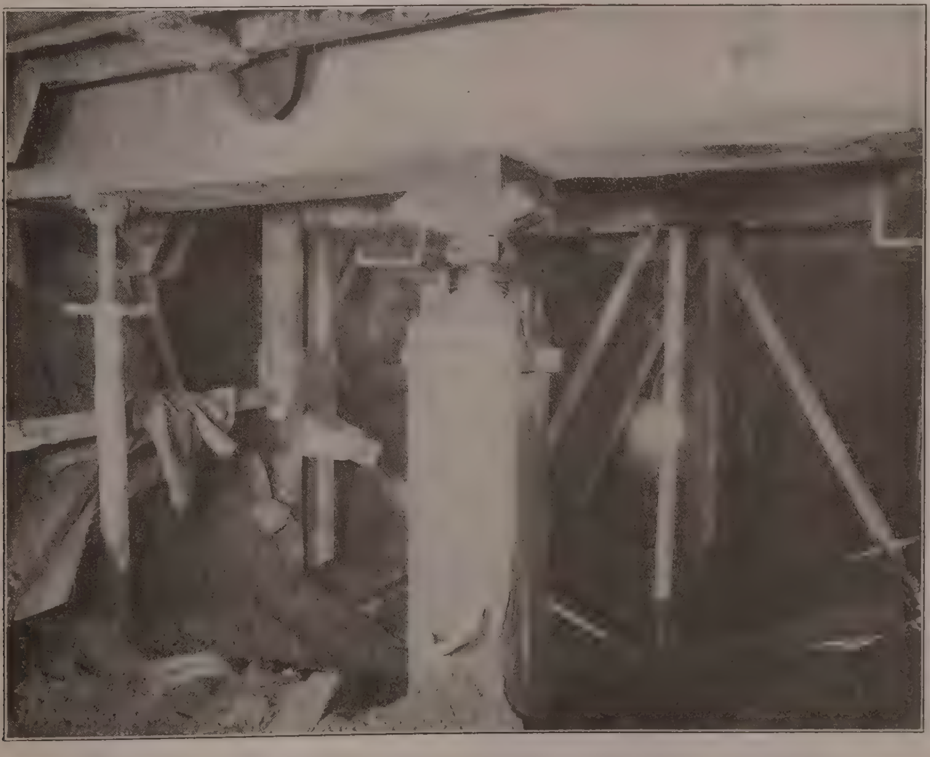

FORM FRAMEWORK SET UP BETWEEN JACKS WHICH SUPPORT LINING PLATES

The entire volume of concrete is mixed in regular mixers at the two shafts, dropped down a pipe to the pneumatic placing machine and "shot" 600 ft. or more directly into the forms. The 8-in. delivery pipe runs through and ahead of the section being concreted, rises, returns and ends in an elbow and nipple. These feed into steel drop chutes for concreting the invert and side walls, and are taken entirely off in concreting the roof. For the latter work, the end bulkhead of the form is made of bags of sand, fitted together and around the delivery pipe. It is difficult to tell always when the key is full, as back pressure occurs before all the air is out of the forms. With the care exercised on this contract, however, very good results have been secured. This method allows the concrete to be placed considerably faster than the heading can be advanced, and without interfering with the mucking operations.

The bottom half of the sewer is lined with one ring of vitrified brick. This and the comparatively short length of headings led to the adoption of sand-ballasted industrial track and mule haulage for the muck cars. Beginning midway between shafts and at the ends of the section, the lining can be placed as the track is torn up and the ballast removed. Some of the sand can be used directly in laying the bricks. A single track takes muck from each heading as fast as it can be dug. The two mules that have been lowered down each shaft are stabled under ground.

On being hoisted from the shaft, the sand and gravel pass through a screening plant, and much of it is used over again for concrete. Such as will not pass the specifications of the Sewer Department is removed by teams and dump wagons. As the run of the headings is uneven, and as little storage space is available in a plant built on city streets, some concrete materials have to be purchased. The compressor plant for placing the concrete at both shafts is located at Monroe Street, and includes one 1050-ft. and one 600-ft. electrically driven machine. The hoisting plant at each shaft consists of a derrick mounted on the overhead structure within reach of the shaft and the bins. Cement storage at both shafts is provided for under the bins and directly behind the mixer, which is set up at the edge of the shaft.

The contractor for this section is the Litchfield Construction Company, for whom the work is under the direction of J. W. Goodridge, vice-president. For the Brooklyn Sewer Department E. J. Fort is chief engineer and George T. Hammond designing engineer. Arthur J. Griffin is engineer of construction for this and other work, and I. H. Kirby is assistant engineer in charge of the section described.


INVERT FORMS IN PLACE BEHIND BENCH BULKHEAD ARE BRACED FROM NEEDLE BEAM

Check Dams Approved by Investigating Committee

THAT check dams would prove to be a potential agency in the general scheme of water conservation and flood control is the substance of the report made by a committee appointed by the city of Glendora, Cal., to inspect the experimental dams in Haines Canyon. Following the report of the committee, the Glendora Flood Control Association, organized since the January floods in southern California, has decided to construct check dams in the Big and Little Dalton Canyons, which carry the run-off from the watershed upon which the ranchers of this valley depend for their supply of water during the irrigating season. To finance this work a levy of $2.50 per acre will be made on land liable to damage from flood waters in this vicinity.

Cracks in 16 of 300 Concrete Road Slabs Analyzed

Very Little Wear Observed on Baltimore Highway After Sixteen Months' Service

By P. A. BEATTY
Loch Raven, Md.

IN connection with the Gunpowder water supply improvement for the city of Baltimore the Water Board constructed several miles of new highway, about 1½ miles of which were surfaced with plain concrete slabs, 14 ft. in width, 7¼ in. thick at the center and 6 in. thick at the sides. Joints were spaced 25 ft. apart. The sub-grade was well rolled and sprinkled before placing the concrete, which was carefully inspected. The screeded surface was broomed to show well-defined transverse lines, and was well protected, first with canvas, and later with earth; it was frequently wetted down to prevent too rapid drying out. Two weeks after completion it was put in service.

A careful inspection made on Feb. 8, after the road had been in service about 16 months, under a fairly heavy country traffic, showed that very little wear had taken place, the brush marks still being plainly discernible everywhere, and at most places looking as fresh as ever.

Sixteen Slabs Cracked

Of approximately 300 slabs, sixteen showed cracks. Six cracked slabs were on fills, and evidently due to settlement. Four were cracked approximately along the center, from end to end, although the cracks were not continuous. In six slabs the cracks started approximately at the middle at one end, but ran out to the side about two-thirds of the way up with a sweeping curve. One had an 18-in. crack in one corner, which did not reach the edge. One had a transverse crack about the middle. All, except the six classified as settlement cracks, were in cuts, where the original soil had not been disturbed, the sub-grade being clay.

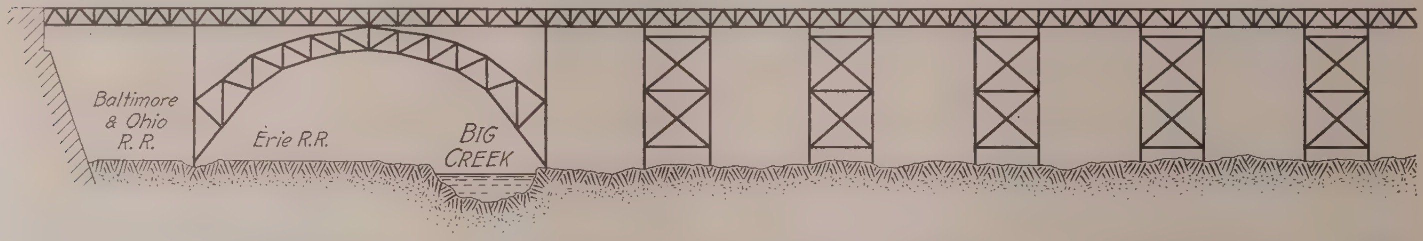
In no case, except in the settlement cracks, were the cracks continuous; they consisted of short fractures with the ends approaching, and often lapping, but an inch or two apart. No spalling had occurred at the edges of these, and only a few were of sufficient width to receive the end of a small pin. Many of the cracks would have remained unnoticed except that the moisture which they contained made them visible. It is not known whether they extended through the slab, or were superficial. In the latter case the moisture must have come from above, or that which the slab contained must have concentrated at or been made apparent by the cracks, as the slabs did not look damp.

There seems reason to expect that these cracks will widen, owing to repeated freezing of this moisture, but two winters' exposure so far have caused little apparent damage. The writer does not believe that these cracks were caused originally by external causes, although they may have been rendered apparent by frost action. Their appearance suggests the idea of internal stressing of the concrete. One would not expect insufficient hydration to produce these results. There seems to be some significance in the fact that all of the cracks occurred in cuts, where the moisture might be expected to be greater than on fills. That, combined, perhaps, with temperature changes, might have some bearing. The writer would be glad if some of your readers would give their experience and express their views.

Half of Long Steel Viaduct at Cleveland Wrecked in Seven Days

Arch Ribs at Brooklyn-Brighton Structure Thrown Down Bodily After Being Stripped—Cutting Torches and Single Traveler Used

ONE-HALF of the old Brooklyn-Brighton viaduct in Cleveland was wrecked in the week ended Sept. 2 last, with the help of the oxyacetylene torch and a single traveler, to make way for a new concrete structure. This rapid progress, which was three days faster than required by the construction program, was not necessary with the south half of the old viaduct, as the center lines of the old and new structures diverged so that the former cleared the latter for this distance.



THE RIGHT-HAND HALF OF THIS 1562-FOOT VIADUCT IN CLEVELAND WAS WRECKED BY A SINGLE TRAVELER DERRICK IN SEVEN

From the north end the old viaduct, which was built in 1892, consisted of 1322 ft. of alternate 57-ft. and 28-ft. Warren truss spans, the latter directly over steel towers 26 x 28 ft. in top plan and from 25 to 85 ft. in height. Next was a 168-ft. arch span over Big Creek and the Wheeling & Lake Erie Railroad, which was wrecked by dismantling everything but the two arch ribs and throwing these sidewise to the ground. A 72-ft. truss span carrying the roadway over the Baltimore & Ohio Railroad tracks completed the old structure.

New Viaduct Built in Halves

The new viaduct was built in longitudinal halves, the west half being built first and the east half after a large part of the old structure had been taken down. All of the west half of the new bridge could be built without disturbing the old bridge except for a small section at the north end. Timber falsework which did not interfere with the new construction was built to support the roadway at this point, and the old steel was cut up with a blow torch and removed by hand. The quantity taken out in this operation was small, and the work was at no great height from the ground. The old bridge remained in this state until the west half of the new bridge was paved and ready for use on Aug. 25, 1915. As soon as the wires of the street car company had been removed, on Aug. 27, the workmen started tearing up the wooden street decking and erecting a stiffleg traveler derrick of 14 x 14-in. timbers with a 60-ft. boom. This derrick was in operation by 2.30 p. m. of the same day, when actual removal of the old steel was begun. The derrick, which was mounted on skids, rolled back as the bridge was torn down in front of it.

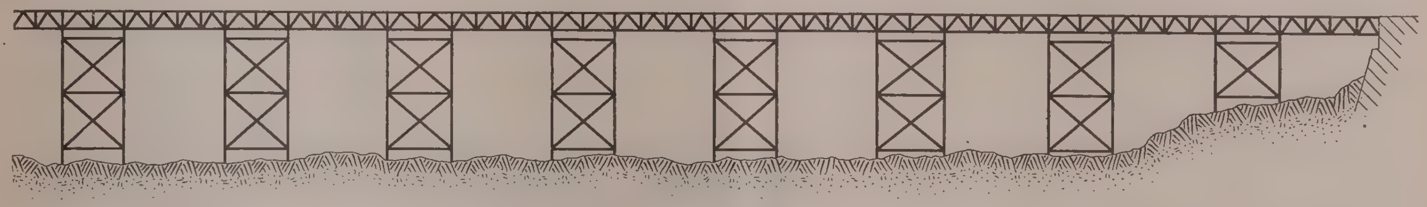
Floor System Cut Out First

In removing the old spans the derrick was set over a tower and from this position took down the spans and the tower behind it as they were cut up. The floor system was made up of longitudinal stringers riveted to floorbeams. Each end of these latter rested on a bracket at a bottom-chord panel point of the truss, and had its top flange riveted to the under side of the top chord of the truss. As the stringers were taken out, the rivets in the bottom flange of the floorbeams were burned off, and the top chord on each end was cut through on each side of the floorbeam, leaving a piece of it attached to the top flange of the floorbeam at each end. This allowed the floorbeams to be lifted and lowered to the ground without time being taken to back out any rivets. The center floorbeam was first removed, and next those on either side of it, to reduce the stress on what was left standing of the trusses. This procedure left the bottom chord of the truss intact and all the diagonals in place, each pair supporting a section of top chord at the panel points. The trusses were next taken down by burning off the diagonals at their lower ends and lowering two diagonals and a section of top chord still fastened together for each pair of cuts made. The two lower chords were then cut at each tower and lowered to the ground full length, where they were cut in two to facilitate shipping.

Removal of Towers

After the truss between two towers was removed in this manner, the tower behind that on which the traveler stood was taken down by cutting out the top set of bracing and burning off the posts at the lower end of this top panel. This left about half of the tower still standing. This lower part was cut up and allowed to fall to the ground, where it was further cut into lengths suitable for loading on cars.

These operations were carried on from one end of the bridge to the other, leaving only the main trusses of the 168-ft. arch span standing after the traveler had passed over it. The arch trusses were wrecked by first removing the top lateral braces, and then taking down the top-chord members, verticals and diagonals simultaneously for both trusses. This work was begun at the center by taking out two panel lengths of top chord and the center post, and removing thereafter one diagonal, one vertical post and one panel length of top chord at a time on each truss, first on one side and then on the other of the center, until nothing remained standing but the two main arch ribs connected by the bottom system of lateral bracing. The way in which this was done is described in detail on page 333 of this issue. The arch ribs were then guyed with six lines each and the bottom laterals cut out. As the east rib was thrown down first, its guys were passed under the west rib and the guys of the west rib passed over it. The ribs were thrown over bodily, one at a time, by pulling on a set of falls hitched to the center of each rib after the anchor bolts had been burned off. The arch ribs fell without breaking up, and were cut up on the ground into car lengths. Blocking was placed over the railroad tracks, and they were not damaged. It was possible with each rib to make two cuts and drag the center piece off the tracks quickly enough to avoid delaying any trains.



DAYS BETWEEN THE COMPLETION OF THE FIRST LONGITUDINAL HALF OF THE NEW VIADUCT AND THE BEGINNING OF THE SECOND HALF

Time Important in Removing First Half

In order to take care of the erection schedule for the new bridge it was necessary to have the north half of the old bridge entirely removed within ten days after starting work on Aug. 27. This meant that the section had to be removed by Sept. 5, which was known to be a difficult matter and was thought by some to be impossible, even working night and day. However, one-half of the whole bridge was down on Sept. 2, three days ahead of time. The remainder of the bridge was not removed until the middle of November, there being no necessity for haste, as it did not interfere with the new structure. No accidents or unforeseen delays were met with in the entire work of removal.

Two Oxweld burners were used steadily, a third being kept in reserve. All of the steel was sold in car-load lots, and was cut up only enough to make loading convenient. It was all sold for scrap, not being fit for any other purpose.

The new Brooklyn-Brighton viaduct was built and the old one was removed by the Bates & Rogers Construction Company, of Chicago, for whom C. S. Smith was superintendent in charge of the viaduct. The work was done for the Bridge Department of Cuyahoga County, Ohio, of which A. W. Zesiger is engineer. W. H. Baker was resident engineer on the work.

The Street-Cleaning Department of Springfield, Ohio, has been completely "motorized," as has its fire department.

Where Possible Would Avoid Muskeg Swamps

J. L. Pickles Discusses Various Expedients to Carry Railroads Over Them, but Thinks It Much Better to Go Around Them

Muskeg swamps should be avoided in railroad location as far as possible, in the estimation of J. L. Pickles, chief engineer of the Duluth, Winnipeg & Pacific Railway. While he outlined various expedients in use to carry railroads over these bogs peculiar to the glacial regions of the north, in discussing the subject at the recent convention of the Minnesota Surveyors and Engineers, Mr. Pickles made it clear that he regarded entire avoidance of the deeper bogs as the safest preventive of trouble. To this end he would eye with suspicion stunted tree growth and luxuriant moss, and would take plenty of soundings during location. To avoid the deep moraines he would even risk criticism by locating reverse curves on apparently level ground. He would also try to keep his subgrade as near the original ground surface as possible to eliminate high and heavy embankments.

His paper, slightly condensed, was as follows:

Origin of Muskeg Swamps

When the continental ice cap receded it left vast quantities of glacial drift composed of all sorts of material varying in size from huge boulders weighing several hundred tons down to an impalpable powder-forming clay. It is owing to this glacial invasion that the surface differs from the normal type in the minor topography and drainage. The whole plateau is deeply covered with glacial deposits, which have disarranged the drainage so that there are abundant lakes, swamps and muskegs. Overlying the glacial drift and under the swamp is usually found a stratum of impervious blue clay.

As the ice melted, the materials were deposited as a mantle of glacial drift. These were deposited in moraines and in a very irregular manner, so that the topography of the country did not conform to the usual regularity presented by country formed by the erosive action of water. Huge quantities of ice were left embedded, afterward melting, which formed large circular depressions or kettles. These became filled with water in the form of lakes. The muskeg is of recent formation and is composed of decayed moss and various vegetable growth, which, by constant decay and renewal, gradually filled the depressions, until we have what is known to-day as muskeg swamps.

Ample Soundings Should Be Taken

As the added formation does not bear the regular contours usually found, it is very necessary in determining locations over these swamps that a thorough investigation should be made to determine the contours of the hard bottom. We are too apt to take it for granted that the muskeg is but a shallow formation, and trust our road to be supported by the decayed vegetation, rather than to accept the country surrounding these swamps, which is invariably covered with very thick vegetation. There is a great temptation to run our lines through the open country in order to avoid a more difficult location on higher ground. In locations over such swamps it would be well for the engineer to proceed in the same manner as he would in locating over frozen lakes, and not trust the moss covering to support his line until he has thoroughly tested the same and ascertained what the bearing value of the soil is. In testing it will quite often be found that the surface is floating and the lake is not yet filled to the bottom. In such cases disaster is sure to follow unless adequate measures are taken to support the track. It would be much better to introduce curvature in the alignment, in order to keep the location over shallow swamps, than to produce long tangents crossing over deep pockets. It would, of course, take a great deal of stamina on the part of any engineer to introduce apparent reverse curves on what appears to be level ground; but while this would undoubtedly cause a great deal of criticism of his location, it would in some instances be a very great economy.

Vegetation as an Index

Generally speaking it will be found that the smaller the tree growth and the more luxuriant the growth of the moss, the deeper will be the muskeg, but I have not as yet been able to ascertain anything more than a very approximate depth by such observations. The areas found void of tree growth should be regarded with suspicion, as this usually indicates deep and recent formation, and quite often indicates floating bog.

It has been found in some of the lines already constructed that, had adequate soundings been made previous to final locations, a great deal of money could have been saved over what was necessarily spent to bring the road up to the required standard after operation was begun. As a concrete example, I would like to draw your attention to a line, heavily corduroyed, which broke through before traffic was started. Soundings taken on the center line after the failure showed a depth of about 60 ft. to apparently hard bottom. About 83,000 yd. of material were required to bring the track above water. A great deal of time and money was lost, due to the failure of the surface. All of this would have been avoided had adequate soundings been taken during the location, and money and time lost in this one instance would have been much more than required for the entire line.

In railroad construction over muskeg swamps, the methods in general use are:

1. To follow out the usual form of construction, laying the track directly on the surface and afterward ballasting up to grade.
2. To corduroy or crossway the surface, using long timbers, laying them in alternative layers parallel and transverse to the line, afterward bringing the track to grade with ballast.
3. To excavate ditches along the side of the line, using the material excavated to form embankment.
4. To use sawdust, cinders or other light material, floating the line over and depending on the buoyancy of the muskeg for support.
5. To fill to the bottom with logs and timber.
6. To fill with excavated material.
7. To use a bridge.
8. Where considerable embankment is to be carried over the swamp, to drive piles on about 4-ft. centers, cap them with timber grillage and construct the fill on the same.

DRAINAGE

Drainage is often resorted to with very beneficial results. However, in many instances where deep muskeg is encountered, it is not practical to drain, due to large lakes in the vicinity and exceptionally heavy expense required due to great length of ditches which it would be necessary to construct. Ditches cut in muskeg are prone to close, and it is a constant source of expense to keep them open. Again, it will usually be found that there is no place to stop the ditch without carrying it to an unreasonable distance. And while such ditches are always of more benefit to the surrounding country than to the roads constructing them, they invariably bring on a system of suits in which the company is usually the loser. It is for this reason alone that many of the swamps in the northern part of the state [Minnesota] are not drained.

Whatever the construction decided upon, it must be borne in mind that a good foundation must be obtained, otherwise there will be a constant source of expense and trouble from rail running, causing broken rails, derailments and a constant settlement, which will result in very heavy maintenance charges.

In locations over this country, it is well to keep the grade as near the surface as good drainage will permit, in order not to overload the surface by the weight of heavy embankments, which are apt to break through the surface and in some instances will cause rupture through the underlying strata into the substrata, which are of an older formation but not yet solidified sufficiently to carry the increased load.

Swamps are like wrecks, there are no two of them alike, and they are very good things to avoid if at all possible.

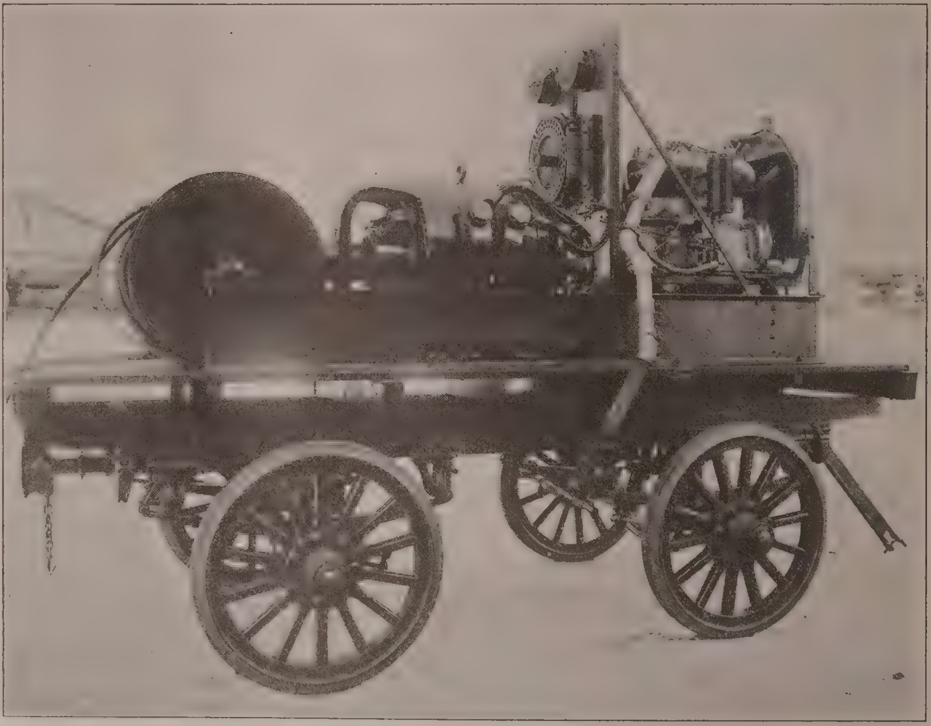
California Bridge Fails When Wreckage Lodges Against Pier

THE HIGHWAY bridge across the San Luis Rey River, San Diego County, California, was 690 ft. long and consisted of six 100-ft. arches and the two approaches. The structure was supported on concrete piers, which in turn were founded on piles with tops cut off below low-water level. It is reported that when the flood of Jan. 27 was at its crest, a piece of wreckage resembling the floor of a small highway bridge drifted down and lodged against the center pier of the structure. The current held it in place and other drift swept against it so that it was forced into a vertical position. In this position it deflected a strong current downward which seemed to produce serious scouring effects, as not long afterward the center pier was moved downstream and disappeared beneath the flood. After the collapse of the central arches the others soon followed, and the bridge was completely carried away from shore to shore.

St. Paul Builds Equipment for Thawing Frozen Pipes

Apparatus Mounted on Truck, Which Is Used for General Service in Summer, Clears Ice-Clogged Mains in 15 Minutes

A THAWING outfit, put into service within the past month, has enabled the St. Paul, Minn., Waterworks Department to thaw out any frozen water service on which it has been tried within a maximum of 15 min. In one case a temporary main, thawed out in this time several weeks ago, had also been frozen the previous winter, but on that occasion the residences served were without water for four days. The apparatus consists of a gasoline engine direct-connected to a generator, a switchboard and a reel of cable, the whole mounted on a structural steel frame, so that it can be handled as a unit.



THIS APPARATUS THAWS FROZEN WATER SERVICES IN FROM 5 TO 15 MINUTES

DETAILS OF THAWING UNIT

The arrangement of the equipment is clearly shown in the accompanying illustration. The four-cycle, four-cylinder gasoline engine, built by the Capitol Engine Works, St. Paul, is direct-connected by a leather-link flexible coupling to a Roth Brothers 20-kw. 40-volt direct-current generator. A voltmeter, an ammeter, a rheostat and a single-pole knife switch of 500-amp. capacity are mounted on the switchboard. The reel holds 500 ft. of extra-flexible copper cable of 300,000 circ. mils cross-section, in 100-ft. lengths. Each length is fitted with terminal lugs. The various parts of the equipment are securely attached to the steel frame, making the equipment easily portable. For service the equipment is mounted on a Troy trailer of 1½-ton capacity, which is hauled about by a motor truck. The mounting is not permanent, and after the winter season the thawing unit will be removed and the trailer used for other purposes.

METHOD OF USING

To thaw out a service one pole of the generator is connected, in the premises, to the pipe between the meter and the street main. The other pole is connected with the nearest fire hydrant. Thawing is effected in from 5 to 15 min. after the current is turned on.

When the construction of the thawing unit was originally determined on by G. O. House, general superintendent of the department, a design was considered whereby the generator would be driven through the medium of a belt from the engine of a motor truck. The mechanism would have been so complicated that this design was abandoned in favor of the scheme carried out.

The apparatus was developed under the direction of Mr. House, and was assembled by E. L. Sudheimer of St. Paul.

THE CROSS-SECTIONING AND TRACK INVENTORY WORK in the federal valuation of the Boston & Albany Railroad has been done mainly by men in the employ of the railroad, the government merely having a recorder with each party, stated J. C. Irwin, assistant valuation engineer of that road, before the Boston Society of Civil Engineers, in discussing the paper by F. C. Shepherd, valuation engineer of the Boston & Maine Railroad, on the valuation of the Boston & Maine. (See the Engineering Record of Oct. 30, 1915, page 538.) Usually, on other roads, the government has been providing the party and the railroad has furnished a pilot only.

What Is an Engineer?

Carnegie Foundation Sends Out Second Letter to Get Views as to Relative Value of Technical and Other Attributes

AS ANNOUNCED by Prof. C. R. Mann of the Carnegie Foundation at the recent annual meeting of the American Society of Civil Engineers (see the Engineering Record of Jan. 22, page 125), the Foundation is sending out a second circular letter and mailing card to the members of the engineering societies to get further light on the question, "What is an engineer?" The letter is as follows:

DEAR SIR: Last spring we consulted you on the subject of engineering education, concerning the qualities that you look for in young engineers and the general effectiveness of the engineering schools in producing such men as you want.

The replies that have been received mention many factors that are essential to the successful engineer. These essential factors fall naturally into the following six groups, which are named in the order of their importance as determined by their frequency of occurrence in the replies.

1. **Character**, integrity, responsibility, resourcefulness, initiative.
2. **Judgment**, common sense, scientific attitude, perspective.
3. **Efficiency**, thoroughness, accuracy, industry.
4. **Understanding of men**, executive ability.
5. **Knowledge** of the fundamentals of engineering science.
6. **Technique** of practice and of business.

If this is a correct definition of the essential characteristics of an engineer, it furnishes the necessary basis for a rational discussion of the effectiveness of the schools. It can also be used as a standard in developing staff organizations and curricula, and in selecting efficient methods of instruction.

The best way in which engineers can aid the schools in solving problems in connection with engineering education is by defining the product which they desire. We therefore urge you to contribute to this important cause by numbering the six groups on the inclosed card in the order of importance which you give them in judging the reasons for engineering success and in sizing up young men for employment or for promotion.

Yours very truly,
C. R. MANN.

P. S.—We shall be glad to keep you informed of the progress of this study if you are interested.

The mailing card gives the same six groups, in the same order, but omits the numbers and asks the voter to indicate the order of importance he gives them at the beginning of each line. The voter is also asked to give his name and address, and the number of years he has been in practice.

Readers of the Engineering Record are invited to vote on the matter, sending their replies to the Carnegie Foundation for the Advancement of Teaching, 576 Fifth Avenue, New York City.

A TOTAL OF 24,000 TONS OF EXHIBITS, constituting practically all of the displays at the Panama-Pacific Exposition, have been shipped from the exposition. Of this total about two-thirds has been handled by outgoing railroads and the remainder by steamship lines.

Concrete Flows Under Sustained Load

Earl C. Smith Cites Results of Tests of Concrete Beam and Cylinders Showing Continued Increase in Deformation with Constant Load

THAT CONCRETE subjected to long-continued sustained loads exhibits a continually increasing deformation or "flow" is shown by Earl B. Smith, associate mechanical engineer, U. S. Office of Public Roads, Washington, D. C., in a paper presented at the annual meeting of the American Concrete Institute. The paper is here reproduced practically in full:

HOOKE'S LAW ONLY APPROXIMATE

The ordinary conception of the behavior of materials under stress is that it follows Hooke's law for both increasing and decreasing loads within the limit of elasticity. As a matter of fact, this straight-line relation between stress and deformation is only approximately true for any material. There is an elastic-hysteresis phenomenon (see the article by the author on "Elastic Hysteresis" in the Engineering Record of May 17, 1913, page 561) in all cases of loading and unloading a material which makes the relation between stress and deformation only approximately constant.

Although structural metals do not exactly follow this straight-line law, they so nearly do that stress computations based upon their deformations are approximately constant and independent of any time factor. It has long been realized that the deformations of stressed concrete are not even an approximately constant function of the stresses, but the effect of any time factor or of continually sustained loads has been almost entirely overlooked.

While making some tests on large reinforced-concrete slabs, in August, 1914, the writer noticed the large variation in the concrete deformations under a constant stress, and was unable to make any check readings after an elapsed time of one hour or more, even when the temperature and moisture conditions were constant. After considerable search for the cause of these variations there was discovered an apparently definite relation between them and the elapsed time. Several experiments were made with the object of determining the amount of "flow" in the concrete, with respect to the time factor, under sustained loads.

DESCRIPTION OF TEST BEAM

A 5 x 8-in. reinforced-concrete beam was cast, and at the age of about two weeks was placed on two supports of 10 ft. clear span and loaded at the center with a single concentrated load of 1225 lb. The effective depth was 7 in. and the reinforcing amounted to approximately 0.75 per cent, and consisted of five ¼-in. Havemeyer rods. The concrete was 1:2:4 gravel.

The strain-gage points were placed 8 in. apart on the top of the beam, which permitted readings to be made along its whole length and thus give the concrete deformations for different fiber-stress values. The beam when loaded had a computed fiber stress of approximately 1000 lb. at the center section, 60 in. from the support; the fiber stress at the 30-in. section would then be about 500 lb., and at other sections in proportion to their position.

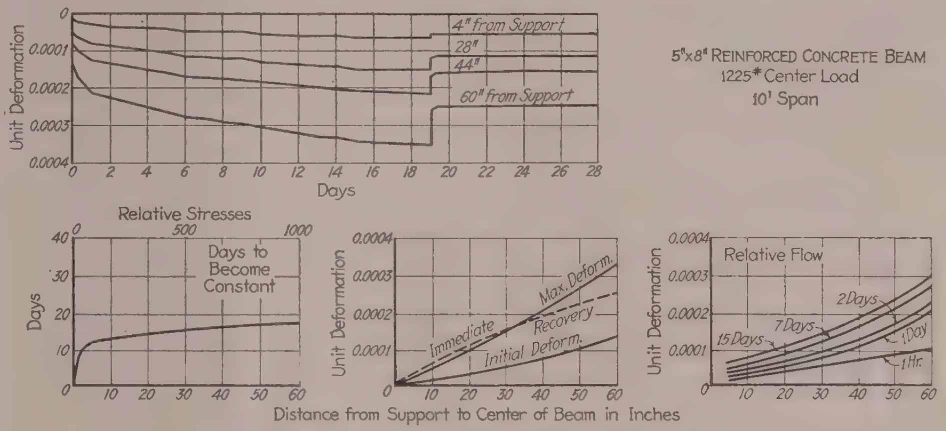


FIG. 1—CONCRETE BEAM SHOWS CONTINUED DEFORMATION UNDER CONSTANT LOAD

RESULTS OF TEST

The results of this test are shown graphically in Fig. 1. The flow of the concrete for four fiber-stress values (which are indicated by the position of the strain-gage points in inches from the support) is shown in the upper curves. The load was sustained at the constant value of 1225 lb. for 19 days and then released, deformations being read once each day. The first day the deformation readings were taken every two to four hours. These curves contain in their results the effect of the natural contraction of the concrete while hardening.

When the deformations become constant, the flow has attained its maximum value and has ceased. The time necessary for this to occur under the different stress values is shown by the curve in the lower left-hand corner. It should be noted that it has required about two weeks for concrete to attain its maximum deformation with a fiber stress of 500 lb. under the conditions of this test.

The group of curves shown in the lower center indicates the initial deformation, the maximum deformation and the initial or immediate recovery of the beam for the different stress values. The relative flow for the different stress conditions at different elapsed times from the application of the load is shown in the group of curves in the lower right-hand corner of Fig. 1. These curves indicate the large increase of deformation which may be expected for short-time lapses.

The flow of concrete under a simple compressive load was obtained by testing a cylinder loaded to 700 lb. per square inch. The cylinder was 6 in. in diameter and 24 in. long, of 1:2:4 gravel concrete. The strain-gage points were 20 in. apart, and readings were made once each day. A companion cylinder exactly like the first and prepared in the same manner was used, without being loaded, to obtain contraction data for correcting the deformations of the loaded cylinders, thus giving the net flow due to the load. These cylinders were cured for 29 days in wet sand, and then allowed to dry out for 7 days before beginning the test.

The results on these dry cylinders are shown by the curve *A* in Fig. 2, which gives the values of the net flow. The curve is corrected for contraction effect. A second set of companion cylinders of the same size were tested in exactly the same manner, except that they were kept saturated. The flow results on these wet cylinders are shown by curve *B*, Fig. 2, the net flow only being shown.

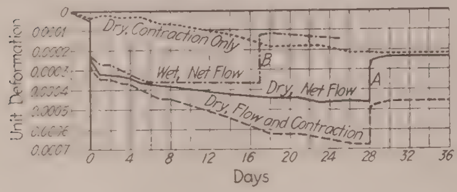


FIG. 2—CONCRETE CYLINDERS FLOW UNDER CONSTANT 700-POUND UNIT STRESS

TWO FACTORS IN DEFORMATION

The deformation of concrete due to stress contains two factors, one of which is probably somewhat elastic, and the other a molecular displacement or flow; the magnitude of the flow factor is dependent upon the time.

The determination of stress values in concrete structures from the deformations of the concrete is rather questionable, and entirely dependent upon the time factor. Stress values obtained from initial deformations, within only a few minutes after the application of the load, are probably more nearly true than later determinations. The value of the modulus of elasticity to be used in this connection should be determined on a specimen loaded at the same rate and with the deformations read after the same time lapse.

EFFECTS OF FLOW

The effect of flow in most cases is to change or relieve the stress value; where this is impossible there is a gradual change in the length of the member, continuing possibly for several weeks.

In the case of a concrete beam with anchored or confined ends, the temperature stresses are supposed to be very large; but since the temperature expansion is slow, there is time for flow to occur and thus relieve the stress. The amount of relief may be from 25 to 80 per cent of the computed temperature stress, depending on the relative magnitude of the stress and the time factor.

This phenomenon of the flow of concrete may explain the abnormal stress conditions which apparently exist in some structures. Concrete roads and pavements, constantly subject to expansion and contraction, due to moisture and temperature, in many cases do not crack where they apparently should. Concrete arches may also be largely protected from excessive temperature stresses by the flow of the material.

This subject needs much investigation to establish its exact effect and magnitude before it should be considered as a factor in design. At present it should be used only as a possible explanation of certain deformation and stress phenomena.

Letters to the Editor

Comment on matters of interest to engineers and contractors will be welcomed

Greenheart Timber for Canal and Harbor Works

SIR: In your issues of Jan. 29 and Feb. 6, pages 149 and 180 respectively, A. K. Armstrong points out the exceptional merits of greenheart timber and gives a valuable summary of its properties.

The writer has never been able to understand why this remarkable material has remained almost completely unknown in the United States. In Great Britain and the Continent it has long been the standard timber for high-grade harbor works, and has also been extensively employed in South America, India and elsewhere. It has great strength and stiffness, and its durability even in very moist and hot climates is remarkable, while its resistance to the attacks of marine borers is greater than that of any other timber suitable for engineering works. In some English lockgates greenheart has remained in excellent condition after more than 100 years of use. It would, therefore, appear to be exactly the material needed, in the teredo-infested waters of our Atlantic Gulf and Pacific coasts, and for trestles in hot and humid parts of the country.

Nor need the question of cost stand in the way. In heavy and medium sizes it can be delivered in the United States at prices not exceeding $60 per 1000 ft.b.m., or about the cost of creosoted yellow pine of the same dimension.

Mr. Armstrong refers to the use of greenheart on the Panama Canal. It must be confessed that the amount used there was not very great, less than 150,000 ft.b.m. in all. It was employed only for the sills and fender timbers of the mitering lockgates, and the quoin and miter posts of the drydock gates. For these parts it was recommended by the writer after a personal inspection of greenheart gates at Cardiff and other British ports. The Panama gates were too large to be built entirely of timber, though greenheart gates are probably more desirable as a whole than those of steel.

The timber used at Panama came from Georgetown, British Guiana, only a few hundred miles from the Isthmus, but, strange to say, was shipped via New York, owing to lack of direct steamer lines. It was inspected by a local engineer who had inspected all the greenheart for the Manchester Canal, and the cost of the inspection was moderate.

The separate pieces came to the Isthmus smoothly planed. The ends were painted and, in some cases, banded with hoop iron to prevent checking in the hot sun. It was also deemed wise to store them under water in the lock sumps until required by the erectors. No difficulty was met with in obtaining a watertight closure at the sills.

Greenheart is handled by few American firms, but may be obtained through brokers in New York, Philadelphia or London, or by direct correspondence with the mills through the American consul at Georgetown, Demarara.

It is to be hoped that Mr. Armstrong's interesting article may lead to greenheart being tried on a fairly extensive scale on some large work in the United States.

HENRY GOLDMARK,
Consulting Engineer.
New York City.

The Economic Side of Sand Testing

SIR: I have read W. B. Fuller's notes on the criticism of Chapman and Johnson's article on the economic side of sand testing, which I recently offered (see the Engineering Record of Feb. 5, page 188, and that of Feb. 19, page 260) and am pleased to note that the "blended mixture" adopted by me proved to agree so closely with the "ideal" as brought out by Mr. Fuller's later investigations.

I wish to correct, however, Mr. Fuller's impression as to my "error in attempting to apply Fuller's ideal curve for concrete, to any mixture of cement and sand alone." If Mr. Fuller will read my criticism again, he will perceive that I assumed no responsibility as to the advisability of applying his methods and curves to a mortar, neither did I make any criticism upon that point. I simply pointed out an error in the method used by Chapman and Johnson in the mechanical application of Fuller's theory to an actual problem and proved my contention by actual tests.

With regard to the larger subject, the proper grading of sands for mortars for use in concrete, I have always contended that an ideal curve for cement, sand and stone would not necessarily be correct for cement and sand alone and could not be so used except by reasoning by analogy, which is generally an unwise thing to do.

In the writer's opinion, based upon the results of a considerable number of tests of Indiana sands, the "uniformly" graded or straight-line curve is very nearly the best grading for any given sand for mixtures within the commercial ranges of proportions of cement. However, the writer is inclined to agree with the authors of Technologic Paper 58, Bureau of Standards, in their statement that the so-called "maximum density curve," which is a combination of the straight line and ellipse, does not represent the curve for maximum density except for the particular materials in the tests from which it was derived or very similar materials.

Since there are few natural sands which approximate a straight-line grading, and the sands artificially so graded are in many cases a commercial impracticability, it has been the writer's aim in some recent tests to determine how far above the straight line the curve of the sand may fall without a too great loss of strength and density in the resulting mortar. The investigation also will attempt to determine the equally important question as to whether the relative value of several fine aggregates can be determined by testing them in mortar mixtures. A sand which is so graded as to give maximum density and strength when used in a mortar may or may not give the best results when tested in the combined state with any given coarse aggregate.

H. H. Scofield,
Assistant Professor, Materials Testing,
Purdue University.
Lafayette, Ind.

How to Become an Effective Public Speaker

Sir: Technical journals have repeatedly of late brought to the attention of engineers the value of facility in public speaking. As a rule, however, no attempt has been made to indicate the course to be pursued in developing the desired facility. Possibly, then, some personal experiences and some rules adopted by the writer may be of value to your readers.

Since early manhood the writer has had a very wide experience in addressing both small and large assemblages. While his ability as a speaker may be to some extent a natural gift, it has been developed by arduous work.

For years the practice has been cultivated of making up imaginary speeches, as a pastime, in walking about on business errands or for pleasure. A situation would be imagined and a speech formed to fit the occasion. In this way versatility and readiness have been developed. The plan is recommended to those who are sincerely desirous of developing facility in public discourse.

As a result of experience—of successes and failures—the writer has formulated rules which a speaker will do well to observe.

1. Always prepare well for an address. Short speeches—remarks, they might be better called—need not be written. It is necessary, however, to determine carefully in advance the line of thought to be developed. It is well to make brief notes so that the logical sequence will be observed and none of the important points missed. These notes, written on a small card, may be carried in the pocket or held in the hand when speaking.

2. The important parts of longer addresses had best be written, so that their strong features may be well developed and emphasized. Very important addresses may be written in full. Under no circumstances, however, should the written portions of the address be within the speaker's reach while on the platform. If they are at hand, there is strong temptation to follow the wording slavishly, thus putting a double burden on the mind—the necessity of remembering both the line of thought and the actual words. Vigorous expression, under such circumstances, is impossible. It is best to talk from notes, intent only on presenting the idea, letting the words come as they will.

3. Never *read* a paper. An address from notes is far more effective. If the character of the occasion demands a very scholarly address, the manuscript may be carried to the platform, but the line of thought should be so well in mind that the paper is used only for reference. In no other way can a telling address be delivered.

4. Never speak on a subject unless thoroughly familiar with it. Of course, one is not always forewarned, and extempore remarks are sometimes necessary. However, refuse absolutely to be tempted to talk extempore unless the subject is well in hand. Only then will the words come easily.

5. Unless the subject is unusually important, and there is to be but one speaker, do not speak longer than twenty minutes.

6. If the address is to be short—not over ten minutes—it is well to develop only one idea. That is the best way to grip the audience. They must catch things quickly. Two or three lines of thought confuse or tire them, and at the end of the address no salient point stands out clearly in their memories. To make a lasting impression, develop only one idea, presented, if you will, from various angles.

These rules relate to the preparation of an address. The four following suggest specific means of holding the attention of the audience:

1. Talk straight at the audience.
2. Mean everything you say and put your whole personality back of your words. Let your voice and your facial expression be in harmony with the seriousness, the determination, the enthusiasm, the horror, the graciousness of your words.
3. Be in a fine physical condition. Forceful public speaking is a hard physical strain. When one is nervous or weak, strong expression is impossible.
4. Use gestures if you can, but only if they come naturally.

The writer would add that but comparatively little time is needed to develop effectiveness. Odd moments and idle time when walking to business engagements can be profitably improved by picturing situations and framing a few remarks to fit the occasion. In the writer's case, the time that he has devoted to developing effectiveness on the platform has been repaid a hundredfold.

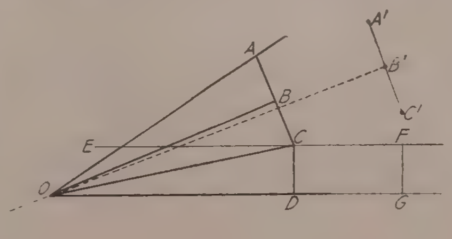
Engineer.
New York.

To Trisect an Angle

Sir: Your "impossible" "ruler and compass" man cannot trisect an angle, for he needs a scale and a couple of triangles. People who have occasion to trisect angles usually have tools enough to do their work. Particularly do I want to show my appreciation for the efforts of the two gentlemen who had the ambition to try the "impossible."

Here is a drafting-room method that you will find quite accurate and theoretically true.

Take any angle AOG and parallel to one side, as OG, draw a line EF, whose point F is visibly below the point of trisection of the angle. Then with two triangles back to back, or with a piece of transparent material with the line OB' marked on it and A' and C' located at right angles to OB' and at a distance each of FG from the point B', slide along with the line OB', always passing through O until A' and C' rest on the lines OA and EF, respectively. Mark the point B', now B; A' becomes A and C' becomes C.



Draw radial lines from O through B and C. These trisect the angle.

Proof: $FG = CD$; $BC = AB = CD$ by hypothesis.

It will be noted that the three right-angled triangles are similar and equal, having two sides evidently equal to the same triangle, hence equal to each other. This will work even on an angle of 180 deg.

Jno. E. Walker,
Office Engineer, El Paso & Southwestern System.
El Paso, Tex.

Sir: In the letter published in the Engineering Record of Jan. 8, 1916, page 57, a construction was proposed for the trisection of any angle. It has of course been well known for many generations that (as was remarked in the consequent letters in the issue of Jan. 22, page 122), with the exception of a few special cases, such as angles of 90 deg., the trisection of an angle by direct work with straightedge and compass is not possible, but that some of the attempted constructions are fairly close approximations. Accordingly, being curious to ascertain the amount of the error resulting from this proposed construction, during a leisure afternoon I carried out the rather lengthy series of trigonometric computations necessary to determine the error for each of a series of angles increasing by 5 or 10 deg. differences from 0 to 180 deg.

If the angle is very small, near zero, the error of this construction is an infinitesimal percentage of the angle; if the angle is acute, the middle "third" as determined by the construction is greater than the portions on each side; the error is greater for larger angles up to angles of about 50 deg., when the middle one of the alleged thirds is about 10 min. greater than each of the remaining angles or arcs; the error is less for larger acute angles up to 90 deg., which is correctly divided, but 90 deg. can be exactly trisected by other very simple methods. If the angle is obtuse, the middle portion is smaller than the other two, the maximum difference being about 11 min. and occurring with angles of about 120 deg.; an angle of 180 deg. is precisely trisected, but simpler constructions will also do that.

In other words, if an angle is divided according to this proposed construction, and if absolutely perfect mechanical work can be done, no one of the parts will be as much as 8′ greater or less than a correct third of the whole angle; this is an unusually close approximation that has been happened upon. But when it is considered how many steps there are in the construction, each of which necessarily introduces a slight inaccuracy in the mechanical work in addition to the original theoretical error of the construction, it is seen at once that by successive approximations with a pair of dividers an arc or angle can be trisected much more accurately in a quarter of the time that this construction would require.

The same remark will apply to the construction for trisecting an angle described by a letter in the Engineering Record of July 31, 1915. That construction like many others proposed for the same purpose, gave theoretically correct results, but required in the process the construction of one of the curves of higher than second degree, which if a draftsman is equipped merely with straightedge and compasses or dividers can be obtained only by marking out a series of points on the curve and drawing the curve through them freehand; this is more laborious and less accurate mechanically than the method of trisection by successive trial with dividers, which will quickly give results so close that the error is inappreciable or invisible, although it is mathematically not a method but mere guesswork.

E. F. CHANDLER,
Professor of Civil Engineering, University of North Dakota.
University, N. D.

[The Engineering Record has received other interesting approximate solutions of this problem, but believes it will be necessary to terminate the discussion at this point.—EDITOR.]

Writing Land Descriptions

SIR: I am very much interested in Mr. L. L. Mills' letter entitled "Writing Land Descriptions," which appeared in your issue of Feb. 19, page 260. Mr. Mills is discussing this matter along the right line, but he does not go far enough.

For a number of years I have been actively engaged in land surveys in the Virginias where the rectangular system of land surveys is not in vogue. During the last two years I have been surveying mountain lands for the U. S. Forest Service and have adopted their methods. In our work it is, of course, necessary for us to get our data from which to work from the county records, and these descriptions have, in the majority of cases, been quite inadequate to locate properly the tracts on the ground. In fact, in a number of cases, the old descriptions do not in the slightest degree describe the tracts as they actually exist on the ground, and it thus taxes to the utmost the ingenuity of the surveyor when he attempts to retrace the old lines on the ground, and in some cases after he has finally located the tract he can not feel certain that he has it located as it originally existed.

This state of affairs is caused almost exclusively by the incompetence of the surveyor before him, who in most cases was one who should not have been allowed to make land surveys. In this state there are no licensed surveyors, consequently, any layman who can peep through the sights of a compass and can read a compass needle, buys or inherits an old compass that might have been a good one in its time, takes it to a blacksmith shop, repairs it with steel screws or bands, sticks out his shingle and is a finished land surveyor. When he writes his description, the important things in his mind are the bearings and distances, which in a large measure are incorrect, and he pays very little, if any, attention to the local description and seldom mentions such a thing as a permanent monument. The fact is, he does not want to leave any marks so that a competent surveyor can check him up. Even when he does leave a mark on the ground, it is very difficult to locate because of the inaccuracy of his actual work of surveying and keeping notes.

The county surveyors oftentimes are just such surveyors, who are hale-fellows-well-met with the political party in power, and they are elected to fill these important positions. Their incompetency causes more litigation and strife over property lines and titles to real estate than all other causes combined.

Laws should be enacted taking these positions out of politics entirely and making it necessary for a surveyor of real estate to pass a state examination before he is qualified to do such work, then issue him a license allowing him to do land surveying as a profession. This examination should be a rigid one and only those who certify that they have had at least two full years' actual experience in land surveying as a subordinate should be allowed to take such an examination. At the same time a fixed standard or book of instructions should be issued covering the requirements of a description before it could be admitted to record, and all licensed surveyors should be required to follow these instructions so far as possible.

Then the licensed surveyor or other person qualified to test the accuracy of the description and survey could pass upon and accept or reject the description for recordation as his judgment and experience directed him.

It is hoped that other land surveyors will discuss this matter from its many sides so that the lawmakers may get the experiences of those who have had these problems to deal with as well as their suggestions for remedies.

A FOREST SERVICE SURVEYOR.

SIR: The condition described by Mr. Mills in his letter in the Engineering Record of Feb. 19, page 260, with reference to the descriptions contained in deeds is undoubtedly quite generally true in all parts of the country.

What constitutes a proper description in a deed is perhaps a mooted question, and except in states where title may be acquired by Land Court registration, the requirements for a description in a deed are, generally speaking, that it describe the land sufficiently to identify it. The variety of descriptions that one encounters in examining deeds, and especially those of country districts, indicates very plainly that the provisions of law which require the description to be sufficiently accurate to identify the property are used in a very elastic manner. Identification ought not to presuppose a historical knowledge of the premises, and yet in many deeds, and perhaps the average country deed, the description is so loosely drawn that it is very difficult and sometimes impossible to identify the premises except with the aid of persons who have an intimate knowledge of the same. The same descriptions are handed down generation after generation, referring to walls and fences which have ceased to exist, and to stakes and trees which, because of the intervening years, have decayed. Present abutting owners are seldom referred to, and oftentimes the present name of streets, railroads, streams and other boundaries are omitted as well. Except by visiting the premises no idea is gained as to the extent of the boundaries, owing to a lack of measurements.

In Massachusetts the provisions of law with reference to the registration of land titles by decree of the Land Court offers, perhaps, an ideal solution of the situation. Briefly stated, some of its important features are as follows:

1. The title is examined by expert examiners appointed by the court.
2. The applicant shall file with the application a plan of the land.
3. The plan is prepared in accordance with the explicit requirements of the court and it is required that:

(a) The title state the location, scale, date, name and address of the surveyor.

(b) There be shown the north point, area, town or county lines, name of adjoining owners, passageways, railroads, official street lines, fences, walls, buildings, boundary monuments and any other natural monuments pertinent to the purpose.

(c) In addition to buildings on locus, there be shown such part of all buildings and other physical features on adjoining land as are within ten feet of the boundary line.

(d) The plan have plainly indicated upon it the manner in which each corner, property line and reference point is marked upon the ground.

(e) In addition to the above, there be indicated the measurements and direction of the boundaries—and the precision with which the plan must be executed is carefully laid down by a set of rules issued by the court in which the degree of precision is adjusted by the value of the property, varying from city surveys to timber and isolated properties. The court also orders a sufficient number of permanent monuments to be erected to reproduce all the boundaries.

After the title has been examined, the plan prepared, all interested parties heard, and all other formalities observed, the court issues a decree, in which is included a description of the property in accordance with the plan.

While registration of land by decree of the Land Court is optional with the parties in this state, and requires some stipulations which might be inequitable to owners of isolated and low value properties, it nevertheless offers some fundamental features which ought to be mandatory upon all parties desiring to convey property. Undoubtedly some statute could be indicated which would standardize the preparation of descriptions contained in deeds having due regard to the value of the property involved.

In Mr. Mills' concluding paragraph he indicates in a general way what requirements are necessary to write a description. In this connection it may be said that too many surveyors are ignorant of the many legal features involved in the preparation of plans for conveying property. Many properties abutting on highways, streams and railroads are affected by state, county, city and town authorities which have the right to acquire land by the right of eminent domain. It is also to be assumed that the conveyancer must have in addition to the above some knowledge of surveying principles in order that a correct interpretation may be put upon the plan.

J. HENRY DUFFY.
Cambridge, Mass.

TO PROTECT 7-FOOT STEEL GIRDERS on the outside and avoid the great increase in dead load for such deep girders which would result if cast concrete thick enough to be practicable were used, a cement-gun covering 2 in. thick has been applied. As described by L. M. Hastings in the February *Journal* of the Boston Society of Civil Engineers, this coating was applied to the girders at the shop, which were then transported to the site and erected without starting a discoverable crack. The cost was thus successfully reduced below the price for applying the "gunite" after erection.

HINTS FOR THE CONTRACTOR

Details Which Save Time and Labor on Construction Work

Other articles in this issue of interest to contractors and construction engineers are indexed in the Table of Contents

[*Contributions to this section are solicited, and if found available will be paid for. They must be* SHORT, *and should be accompanied, if possible, by photographs or sketches.*—EDITOR.]

Wood Coffer Against Back of Dam Used in Replacing Masonry

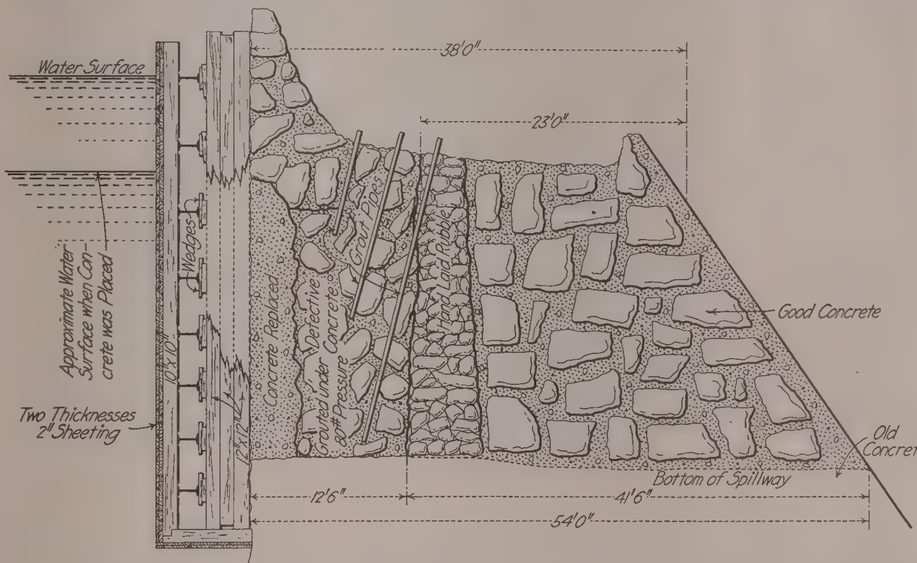
TWO temporary spillways left in constructing the La Boquilla dam of the Northern Mexican Power Company, Ltd., were closed under a considerable head of water by constructing timber shutters across the upstream openings, building a rubble masonry wall across them and filling the space between wall and shutter with concrete in which large stones were bedded. The masonry placed in this space was laid under water, as the shutters could not well be made tight. The east spillway was deeper than the west, and the masonry proved so porous that it was not practicable to grout it. G. G. Underhill, chief engineer, and Edwin Duryea, Jr., consulting engineer for the power company, then decided to replace the back face of this masonry, doing the work in a timber cofferdam seated against the back of the dam. The method is described by them in a recent issue of the *Cornell Civil Engineer*.

The construction of the dam, which is in the State of Chihuahua, Mexico, had been delayed by the difficulty of securing cement. Meanwhile the reservoir filled so that at the time the 33-ft.-wide east spillway was closed it was passing water at a depth of 20 ft. The volume of water descending into the gorge below at high velocity menaced the foundations of the powerhouse, 140 ft. below the spillway floor. By the time it was decided to remove the porous masonry from the back of this spillway section cement had been secured, the dam had been carried considerably higher and the reservoir had filled to about 33 ft. above the bottom of the section to be repaired.

A cofferdam 46 ft. high and braced with horizontal I-beam stringers inside vertical studding was used. Over the latter were nailed two layers of 2-in. plank covered with canvas. Because there was no site convenient for a launchway, the studding, floor and lower part of the sheeting were assembled on shore and handled to place by the two cableways spanning the dam. The cofferdam was completed in place and lowered a few feet at a time as it was built up. On reaching the required depth, the sides and floor of the cofferdam were calked against the back face of the dam with bags, etc., by a diver. Several vertical cross walls of three 12 x 12-in. 50-ft. timbers each were then set and wedged against the I-beams by the diver. These were found far easier to place than crossbraces, and were considered much superior. During the building of the cofferdam it was hung on two 1-in. wire ropes fastened to the floor near the upstream edge and clamped off around blocks hung from eyebolts in the masonry above. These lines pulled the bottom of the cofferdam against the masonry, while the top was held in by short side lines fastened to eyebolts on either side of the section. The lowering was done by two stiffleg derricks, set one on each side of the old spillway, helped when necessary by the cableways. The floor of the cofferdam was weighted with stone to help sink it.

When the cofferdam was in place and braced it was unwatered with three 8-in. centrifugal pumps. As the water was lowered, inclined timber struts were placed from notches in the masonry to blocks bolted to the studs. They were required in addition to the friction of the cofferdam against the masonry to overcome the uplift.

The coffer once pumped out, the work of removing the defective masonry to an average depth of a yard and replacing it with good concrete was readily accomplished, working from the bottom up. This wall provided a solid backing, enabling the interior part of the porous section of concrete to be grouted without difficulty.



COFFER SEATED AGAINST BACK OF HIGH MASONRY DAM WAS BRACED WITH VERTICAL TIMBERS

Hot Water Aids in Unloading Frozen Sand

By G. W. SMITH

Hodgin Construction Company, Omaha, Neb.

SERIOUS difficulty experienced by the contractor on the Ford Assembly Plant at Omaha, Neb., in unloading sand in freezing weather has been overcome by the use of hot water. Platte River sand is being used, and when it arrives at the site it is frozen solid in the cars. The plant for unloading sand and stone consists of a 1¾-yd. clamshell bucket operated by a stiffleg derrick with a 100-ft. boom which swings between the cars and the sand and stone bins. When the sand is frozen, the clam will not penetrate the frost. Three methods for overcoming this difficulty have been tried, the last being distinctly more efficient than the other two. First, an attempt was made to thaw the sand out by the use of steam, which did not prove very successful. Next, picking was tried, but this method proved too expensive in time and labor. The third and successful scheme is to use hot water obtained from an auxiliary boiler used for heating material. The water is allowed to flow through the boiler under city pressure and through a pipe line to the cars. The water penetrates to the bottom of the cars and thaws the sand so thoroughly that it can easily be unloaded with the clam.

Traveler Derrick Converted Into Cableway Removes Steel Arch

A THREE-DRUM hoist provided an extra fall line which was used as an improvised cableway to extend the reach of a traveler derrick in removing the upper members of the 168-ft. steel arch of the old Brooklyn-Brighton viaduct in Cleveland. The work of wrecking the entire structure was carried out by C. S. Smith, superintendent for the Bates & Rogers Construction Company, and is described on page 326 of this issue. This rig differed from the usual "telegraph," or outhall, in important respects which made for more rapid work. After the traveler had backed over the arch, removing the roadway steel, it was stopped for the time on the end of the 72-ft. span beyond. One of the fall lines was run out to a deadman. On it was mounted a sheave with a hook and frame to which the second fall line was attached for a pulling line. In removing the members of the steel arch the pulling line was slacked till the sheave on the track line reached the desired point. The track line was then slacked and the hook on the sheave frame made fast with a short hitch to the member to be raised. As soon as this member was cut free it was hoisted by tightening the track line and hauled in to the traveler with the pulling line. Here the steel was lowered by the pulling line, the track line, of course, being slacked at the same time, to wagons on the railroad right-of-way below. All of the arch members except the main ribs were burned off and removed in this way.

More Devices for Keeping Centrifugal Pumps Running Steadily

By R. E. POST
Superintendent of Construction, United States Reclamation Service, Meadow Creek, Wash.

IN RECENT issues of the Engineering Record various methods have been suggested for keeping the water in a sump low when using centrifugal pumps. The two devices described below have been used successfully at Keechelus dam, under construction by the U. S. Reclamation Service at Meadow Creek, Wash., on which work the writer is superintendent of construction.

The device first used consisted of a bypass with control valve leading from the discharge just above the pump back to the sump. A 3-in. bypass proved large enough to allow the pumps with 6 and 7-in. discharges to run continuously at less than half capacity. By adjusting the bypass valve the level of the water in the sump could be kept constant at any desired point permitted by the suction. When this method is used it is usually necessary to have the sump sheeted on all sides and the bottom floored, as otherwise the discharge from the bypass is likely to cause erosion.

The second device consisted of a gate valve placed in the suction near the pump and adjusted until the water was held at the desired level. This method is very simple, is less trouble to install than the bypass and is better in that there is no danger of damaging the sump. In addition to keeping the water in the sump constant at a low level it is always a great advantage to keep a centrifugal pump running continuously, as by doing so the principal pump troubles—losing of prime and settling of mud in the suction—are eliminated. If alternating-current motors are used for power, as was the case at Keechelus dam, it is still more advantageous to keep the pump running continuously, as frequent starting and stopping causes the starting-box contacts to give out. Whenever this happens their repair causes an annoying and expensive delay in addition to the direct cost of repairs, which is considerable.

The power losses due to the use of either of the schemes proposed are small as the power decreases with the discharge, although not in the same ratio. In this respect the bypass or valve on the suction is thought to have the advantage of a valve on the discharge, although any scheme is worth while which will allow a centrifugal used on construction work to run continuously.

Pneumatic Mixer Moved as Lining Progressed in Long Tunnel

IN THE San Francisquito Canyon the Los Angeles aqueduct is entirely in tunnel from the Clearwater power plant to plant No. 2, with the exception of an 11½-ft. steel siphon, 1000 ft. long, across Bee Canyon. The total length of the tunnel is about 30,000 ft., about three-quarters of which was lined by hand previous to 1915. It was decided to complete the lining by the pneumatic method, and this work was commenced Jan. 1, 1915, on the day-labor plan. From that date the work progressed satisfactorily to completion, the mixer being located inside the tunnel and moved every 1000 ft.

The cost per yard using the machine was somewhat less than with the hand method of placing, but, on the other hand, a greater quantity of concrete was used. Spaces in the arch and around the timbers that would not be filled by the hand method were tightly packed with concrete by the pneumatic method, engineers in charge of the work affirm, due to the velocity with which the mix was driven from the end of the pipe. This was said to be particularly noticeable in the top of the arch where overbreakage occurred when the tunnel was being driven.

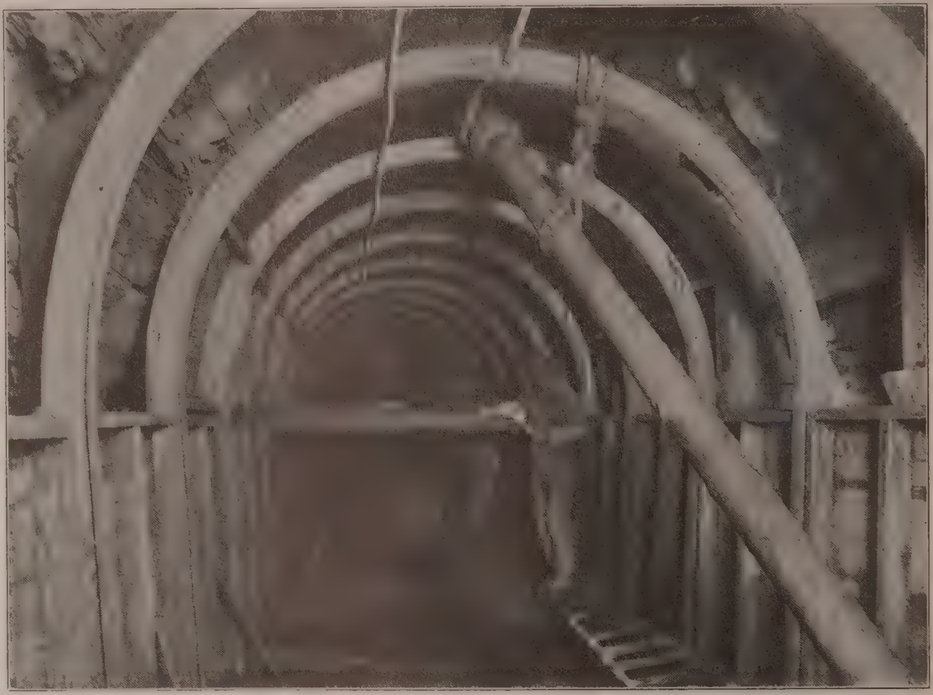
It was decided to use a lining thickness varying from 8 in. to about 18 in. The tunneling in this canyon was almost continuous, the average length between adits being 3500 ft., and it was deemed best to put the pneumatic mixer and connections in the tunnel. It was found feasible to do this and still allow sufficient clearance for the electrically-operated tram cars for hauling material from the portals by enlarging the section somewhat at the points where the pneumatic apparatus was to be installed.

The mixer was supplied with compressed air through a 3-in. pipe line running to a compressor plant consisting of two 550-cu. ft. compressor units. The compressor plant was situated in the bottom of the canyon at a point which averaged about 2 miles from the mixer. From the mixer the concrete was conveyed to the forms through a 6-in. pipe which had a maximum length of about 1000 ft. This length of delivery pipe was used with each new set-up of the mixer, and as the lining progressed the pipe was shortened until the work reached a point within 50 or 100 ft. of the mixer, when the plant was moved on and the full length of the delivery pipe was again used.

The gravel for the mix came from a nearby creek bed whence it was hoisted up an incline into bunkers near the mouth of an adit. Here it passed through a crusher and was loaded into cars. Cement was delivered by the same hoist, and all materials were hauled into the tunnel on tram cars and delivered alongside the mixing plant. At the mixing plant a loading skip operated by an air piston elevated the material for a one-bag batch. Water reached the mixer through a 2½-in. pipe.

The forms used were designed for easy handling, the frame consisting of steel bents on 4-ft. centers supported on timber sills. The bents were made from channel irons joined at the top in the center. The forms themselves were of wood, built in panels and covered with galvanized iron. These were inserted behind the steel bents as the concreting progressed. Ordinarily a section of forms about 75 ft. long was set up and filled each day. Lengths of the 6-in. discharge pipe were removed from the top of the forms when the face of the concrete approached within 2 or 3 ft. of the end of the pipe. In this way, it was affirmed, the concrete was densely packed in the arch.

During the month of May, 1915, a total length of 2356 ft. of tunnel was lined from three setups of the mixing plant. The section of the tunnel was such as to require about 1½ cu. yd. of concrete per linear foot.



SEVENTY-FIVE FEET A DAY WERE LINED BY PNEUMATIC MIXER LOCATED INSIDE THE TUNNEL

The entire crew on one mixing plant consisted of sixteen men, whose assigned duties were as follows: Two scraper drivers, one hoisting man, one motorman, one brakeman, one mix operator, one cement man, two gravel loaders, five men on forms and two handy men.

The machine is being used at the present time to line a section of the pressure tunnel about 4 miles above that referred to in the foregoing, and which contains a large amount of reinforcement. The pneumatic method was chosen for this work because of its advantage in completely filling in around the reinforcing bars.

The work of lining the tunnel was carried out by the city of Los Angeles on the day-labor plan. Part of the work has been done under the general supervision of William Mulholland, chief engineer of the water department, with H. A. Van Norman in immediate charge of the work. The present tunnel lining is being done under the direction of E. F. Scattergood, chief electrical engineer. The pneumatic concrete apparatus is furnished by the Pacific Concrete Placing Company, of San Francisco.

Building Construction in Los Angeles for 1915 totaled $11,888,662 on 7845 permits covering all classes of structures.

NEWS OF THE WEEK

Passing Events in the Civil Engineering and Contracting Fields

Imperial Valley Irrigation System Transfer Effected

On Feb. 24, W. H. Holabird, receiver for the California Development Company, telegraphed the chief engineer at Calexico to turn the irrigation system over to the agents of the Southern Pacific Company. This action was taken after the final cash settlement, approved by judges of the Superior Court, in which agents of the railroad handed over to Receiver Holabird approximately $445,000. In addition there was delivered satisfaction of judgment in the case of the New Liverpool Salt Company and the claim of the Southern Pacific Company.

The total consideration for which the railroad company received the property amounted to $3,875,000. The railroad turned the property over to the Imperial Irrigation District and received in return bonds of the latter.

The purchase of the property of the California Development Company ends many years of litigation, which was started following the breaking into the Salton Sea of the Colorado River.

Oregon County to Spend $750,000 on Roads During Year

Following the voting of a bond issue of $1,813,000, for the hard surfacing of 130 miles of main roads, by a decisive majority, the Board of County Commissioners of Snohomish County, Washington, has authorized the sale of $750,000 in bonds to defray the cost of this year's work.

There are, in all, about 700 miles of road in the county, mostly gravel, but the maintenance, under present day traffic conditions, has been excessive. The roads to be paved will cover the main trunk highways, thus eliminating most expensive ones in maintenance cost.

The proposed improvements are expected to be completed in about three years. The preliminary field work for this year's construction is now under way. It is probable that the greater portion of the roads will be improved by one course concrete paving. In most cases it will be 16 ft. wide, except in one or two cases, where for a short distance it will be only 9 ft. wide. The sub-grade will be flat, with a crown of 2 in. in the 16-ft. roads. The thickness will be 7 in. at the center and 5 in. at the sides, except where the nature of the sub-grade may require particular attention. The work will be done under the direct supervision of W. C. Bickford, county engineer. A. B. Dean is chief deputy engineer.

Change in Philadelphia Subway Plans

Work on the City Hall section of the new Broadway subway in Philadelphia has been temporarily suspended pending the consideration by Mayor Smith of proposed changes in the plans which may be to the benefit of the city. This information was contained in a statement issued by William S. Twining, director of city transit, which indicated that the changes proposed would effect a saving both in time and in cost.

May Create City Planning Commission in Cincinnati

The City Council of Cincinnati has under consideration an ordinance to create a City Planning Commission. The various civic organizations of the city have indorsed the measure and are urging its passage.

The ordinance contemplates giving the commission authority to determine the location of new streets, parks and boulevards, and the enhancing of existing ones, the location of all public buildings, and jurisdiction over the architecture of all bridges, buildings and other structures so as to bring them into harmony with their respective surroundings.

The provision giving the commission authority to designate the height of buildings in various sections of the city has caused a hitch, as it was believed to conflict with the official powers of the building commissioner. The city solicitor and a special committee from the various civic organizations are now at work on a new draft of the ordnance which will eliminate this difficulty.

Railroad Adopts Scheme for St. Paul Union Station

For some years the construction of a union station has been an important issue at St. Paul, Minn. The first proposal seriously considered contemplated a station on the present site. The plan was agreed to by the railroads, and was authorized by the city. The design, however, called for some encroachment on **the Mississippi River and on this account the** consent of the War Department could not be secured.

The Directors of the Union Depot Company have now agreed upon a new plan, and work is under way to secure from the respective railroads the property they must assign in order to allow the scheme to be carried out. Consent of the city will also have to be secured, but since it assented to the original plan, little doubt is entertained that it will agree to the new proposal.

The present station site lies between the river and the alley south of Third Street. This area, as well as that between the alley and Third Street, will be used for trackage under the new plan, while the station house itself will be placed on the block to the north, now occupied by business buildings. The entire square bounded by Third and Fourth Streets on the south and north respectively, and by Sibley and Wabouba Streets on the west and east will be occupied by the main structure, halving the waiting rooms, ticket office, restaurant, etc. Third Street will be bridged over to connect the waiting room with the Concourse above the tracks. Twenty tracks are provided for, 7 stub-ended, and 13 through.

The cost of the earlier plan was estimated at about $15,000,000, and the new scheme will probably approximate the same figure. W. C. Armstrong is chief engineer of the Union Depot Company.

Connecticut Utilities Must Mark Poles

The Public Utilities Commission of Connecticut has issued an order by which utility companies owning, or having custody and maintenance of, a pole or other structure used for supporting electrical conductors are required, before Oct. 1, to mark such a structure with an identifying symbol. On trunk lines in rural districts every fifth pole needs to be so marked.

Alumni Records Indicate Demand for Engineers in Latin America

A scrutiny of the lists of graduates of Massachusetts Institute of Technology, native to Latin-American countries, especially as refers to Brazil, the Argentine and Chili, indicates that the men return home after graduation and engage in their professions in their own lands; that, in fact, the demand for engineers is such that many men from the United States locate in those countries.

Explains How Army Engineers Build Field Fortifications

Following Address by General Leonard Wood, Captain Robins Tells Large Audience of Construction Methods Used for Defensive Works

Cheers greeted Major-Gen. Leonard Wood when he addressed the members of the engineers' military lecture course at the Engineering Societies Building in New York City Monday night. His facts and figures regarding the army's past experiences and future needs served as an introduction to the third regular lecture by Capt. Thomas M. Robins, Corps of Engineers, U. S. Army, who explained the construction features of field fortifications and the methods of procedure followed in sieges and demolitions.

Fortifications of Three Kinds

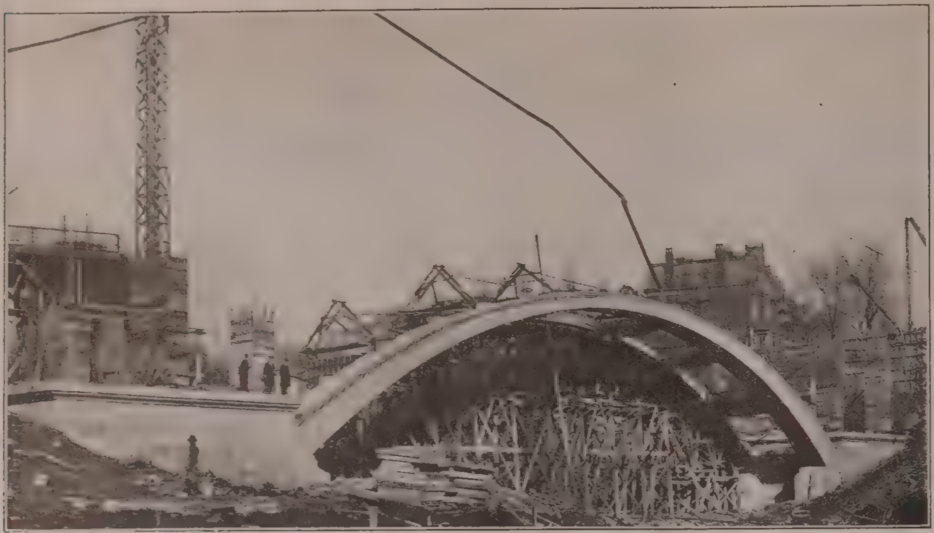
Fortifications were classified by Captain Robins as permanent, semi-permanent and field fortifications. The permanent fortifications, he said, are built in time of peace by civilian labor for the protection of strategic points. Semi-permanent fortifications are less elaborate, and are generally built after the outbreak of war. Works hastily constructed in the field by the troops themselves to increase their fighting power are designated as field fortifications. Hastily built intrenchments are examples of the latter type of construction. Certain terms applicable to trench work were explained by Captain Robins. The "parapet" is the earth thrown up in front of the trench for protection. The "command" of the parapet over any point of the foreground is the difference in elevation between its top and that point. The "relief" of the parapet is its elevation above the ditch in front, although the same term is often used to express its elevation above the bottom of the fire trench. Trenches should not necessarily be located at the crest of the hill, as this leaves a so-called dead space not covered by the fire of the troops. The best location is along what is known as the "military crest," generally a break in the slope in front of the actual crest.

Captain Robins explained in detail the points to be observed in the selection of cover and illustrated with diagrams sections of typical trench work. In choosing a position the principal requirements, it was pointed out, are a wide and clear field of fire to the front; concealment; freedom of movement along and in rear of the position, and security of the flanks.

In discussing some of the accessory features of defensive work Captain Robins emphasized the fact that trenches should not be made continuous, but should be broken at regular intervals by traverses, thus preventing the enemy from enfilading the position. Dummy trenches, in which no troops are stationed, are often used to deceive the enemy and its fire.

Hints on Trench Building

In the construction of rifle trenches the company forms the normal working unit. The company commander, assisted by his lieutenants and non-commissioned officers, marks out the line of the trench, determines the height of parapet and the location of traverses. The men are then deployed along the line, posted at the proper intervals, and begin work. If an attack is likely during the progress of operations, first efforts should be directed toward securing a parapet of sufficient height



VIADUCT BEING BUILT AT CINCINNATI TO REPLACE 52-YEAR-OLD IRON STRUCTURE

Reinforced-concrete bridge, 360 ft. in length including approaches, designed by Frank L. Raschig, assistant city engineer, has 3-ribbed arch span of 180 ft. Portion of old structure used by D. P. Foley, the contractor, to deliver material by gravity to mixer.

to afford cover for the head and a support for the rifle in a prone position, after which the trench is gradually deepened to a standing trench. With the portable tools which engineering troops carry a simple standing rifle trench can be constructed in two hours or less. Captain Robins pointed out that a hot fire from the opposing force can always be counted upon to speed up this work.

Sieges and Demolitions

Captain Robins struck a responsive note when he explained the methods of conducting sieges. The large delegation of subway engineers present from the Public Service Commission exhibited particular interest in his discussion of tunneling work for saps and mines. Mining is the final operation of a siege, resorted to in order to reach the enemy's works and make an assault practicable. The enemy promptly starts counter-mines and a prolonged underground warfare results, each side trying to blow in the other's galleries before a mine can be planted under their own works. The methods of mining generally used are similar to ordinary earth tunnel practice, except, of course, that they are on a much smaller scale. Galleries approximating 7 ft. in width by 6 ft. in height are generally used. They constitute the trunk lines from which smaller galleries branch out.

Demolitions, Captain Robins explained, may be carried out either with or without explosives. Representing work done without explosives are the burning of bridges and brush entanglements, cutting down barbed wire obstructions, disabling locomotives by removal of valves, and tearing up railroad tracks. For the work with explosives the methods used in civil practice are very largely employed. Blocks of trinitrotoluol, measuring 1¾ x 1¾ x 3 in. and weighing ½ lb. are the standards for this work, although sticks also are used, measuring 1¼ in. in diameter and 3 in. long. The caps used are manufactured by a secret process. To demolish ordinary walls the charge per running foot varies with the square of the thickness or $C = 0.85\,T^2$ where C is the charge in pounds and T the thickness in feet. The charge should be placed along the foot of the wall. If the charge is well tamped or placed in a groove and tamped it can be reduced from one-third to one-half.

Masonry arch bridges are best attacked by charging across the extrados at the haunches and crown. The charge should be one-half more than for a wall of the same thickness. Wood trusses are cut near the middle of the lower chord. Steel trusses and girders should have every member cut on the same cross section, preferably near the abutment. A cantilever bridge should be cut over the towers, with regard to rupturing the top chords.

To Aid in Promoting Closer Associations Throughout Americas

The board of direction of the American Society of Civil Engineers on Jan. 17, 1916, authorized the appointment of representatives of the society to act jointly with similar committees of the three other national engineering societies, for the purpose of promoting a closer political, social, scientific, commercial, and industrial association throughout the Americas, and to be known as the Pan-American Engineering Committee.

The following members were appointed as representatives: Fred Lavis, chairman; Chandler Davis, B. F. Cresson, Jr., P. W. Henry, and Edgar Marburg.

Five Miles of Roosevelt Road Washed Out by January Floods

Five miles of Roosevelt Road on the Salt River project, U. S. Reclamation Service, was made impassable, except for pedestrians, by the January floods in Arizona, according to an article by William S. Cone, project manager, in the March issue of the *Reclamation Record.*

Roosevelt Road, which winds down the canyon, just above the water's edge when the river is in its normal stage, was, during the flood, in some places 12 ft. under water. All of the surfacing was washed off, and about 5 miles of it made practically impassable.

The flood water ran over the spillways of Roosevelt Dam to a depth of 11.3 ft.

Plan Outlined for Rehabilitation of San Diego's Waterworks

According to the monthly report of F. M. Lockwood, manager of the operating department of the San Diego Waterworks, water will be purchased from the Cuyamaca Water Company to supply the deficiency in the city's supply pending the completion of the work of piping water from the Upper Otay reservoir. The storm during the latter part of January, and the resulting failure of Otay Dam, described in the Engineering Record, page 191, issue of Feb. 5, and page 225, issue of Feb. 12, as well as that of all the pipe lines leading into the city entail a large amount of work which will have to be done during the balance of the year.

To rehabilitate the water system it is planned to repair the conduit from Morena to Dulzura Summit, allowing the water to flow in its natural channel from the latter point to a point on Dulzura creek, about 5½ miles above the Upper Otay. Thence it will be diverted into a pipe or flume to the upper Otay reservoir. From that point a pipe line will be constructed to the outlet tower at the Lower Otay. The water will be passed through the filter plant, and from there on into the city. The two pipe lines across the Sweetwater River will have to be rebuilt.

It is also planned to install an air lift plant in Mission Valley to bring the water from the wells in the river bottom to the sumps, and from thence into the University Heights reservoir.

Another Engineering Society Is Formed in Chicago

Passage of the structural engineers' license law in Illinois is directly responsible for the new Structural Engineers' Association of Illinois, in the process of formation in Chicago, to maintain the welfare, promote the best interests and safeguard the legal rights and privileges of the structural engineers of the state of Illinois. At a meeting in the rooms of the Western Society of Engineers, Feb. 23, a constitution was adopted. Only licensed engineers are eligible for membership. The initiation fee is $5 and annual dues $10. No initiation fee will be asked of those who join before July 1, 1916.

The government is to be vested in a board of fifteen directors, five of whom are to be elected each year to serve for three years. A full board is to be elected this year, five to serve three years, five two years and five one year.

From a list of eighteen names submitted by Charles B. Burdick, I. F. Stern, E. E. Barrett and H. J. Burt, committee on nominations, the following were elected as directors: Andrews Allen, J. G. Giaver, R. M. Gerety, H. E. Van-

FIVE MILES OF ROOSEVELT ROAD MADE IMPASSABLE BY JANUARY FLOODS derlip, F. H. Hamilton, J. N. Hatch, J. P. Cowing, George Jobst, D. H. Maury, John Brunner, I. F. Stern, C. B. Burdick, H. C. Lothholz, O. A. Bailey and C. C. Brooks. All officers are to be named by the board of directors when they have been elected.

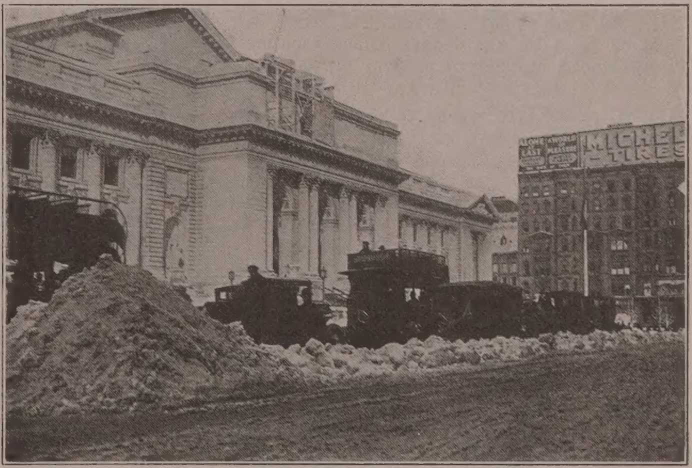
A secretary, not necessarily a member, is to be chosen and the board will fix the conditions of his employment and salary.

Cleveland Holds First Complete Building Show

What was claimed to be the first complete building show in the United States was held in Cleveland last week. Its purpose was to present ideas regarding residence and factory construction to prospective builders and to contractors.

Most of the space was devoted to the exhibit of manufacturers of materials, though house furnishings, such as sanitary fixtures, heaters, etc., occupied considerable space. The Lumber Manufacturers' Associations were there in force, as were also the brick-makers. These two interests, occupying more space than any other, vied with each other in the attractiveness of their display. The brick-makers showed excellent examples of district brick work while the lumber dealers had a model park with nine small dwellings, showing the possibilities of frame construction. The hollow building tile manufacturers, not to be outdone, showed how their materials could be used both for exterior work and as a basis for stucco.

← SNOW PLOWS ATTACHED TO MOTOR TRUCKS ARE USED TO CLEAR NEW YORK'S STREETS AFTER STORMS



→ FIFTH AVENUE, NEW YORK, AFTER PASSAGE OF MOTOR TRUCK SNOW PLOWS

With the purpose of appealing to the contractors quite a number of manufacturers of construction equipment had booths. Among them were the Thew Automatic Shovel Company, the Chain Belt Company, and the Clinton Wire Cloth Company.

Simultaneously with the show were held meetings of the National Paving Brick Manufacturers' Association, the American Ceramic Society, the National Brick Manufacturers' Association and the National Clay Machinery Association.

The admissions to the show totaled about $150,000.

Storm Waters Bring Silt to Los Angeles Harbor

A complete report on the flood damage to Los Angeles harbor during the recent severe storms has been made to the harbor commission by S. A. Jubb, assistant harbor engineer. The report, which was later forwarded to the Rivers and Harbor Committee of Congress, showed that approximately 2,030,000 cu. yd. of silt were deposited in the various basins and channels in the harbor. Of this amount 1,400,000 cu. yd. was deposited in territory where the dredging is done by the federal government, and the harbor commission, in forwarding the report, asks Congress to make an emergency appropriation of $1,080,000 for the diversion dam, so that construction can be started immediately. It is pointed out that the recent storm damage, repetition of which would be obviated by a diversion dam, amounts to 13 per cent of the cost of such a structure. The harbor commission estimates that on a basis of ten cents per yard, the cost to the government will be $140,000 for removing this season's silt deposits. In addition to this sum, it is estimated that it will cost the city and property owners approximately $63,000 to restore their channels.

Military Drill for Engineers

For the benefit of those engineers who plan to attend the military training camp at Plattsburg, N. Y., and others who wish to take up some form of military training, arrangements have been made for a preliminary course of drills during March, April and May. Col. W. G. Bates of the 71st Regiment, N. G. N. Y., and Lieut.-Col. Eugene W. Van C. Lucas, of the 22d Corps of Engineers, N. G. N. Y., have offered the use of their armories with competent instructors

The drills at the 71st Regiment armory, Thirty-third Street and Park Avenue, New York City, will be given every Thursday afternoon, from 5.30 to 7.00 o'clock, under the direction of Capt. George Perrine, assisted by other officers of the regiment. If a sufficient number apply, drills will be held in the 22d Corps of Engineers armory, 168th Street near Broadway, every Tuesday evening at 8.15 o'clock.

These drills will include work similar to that done during the first two weeks at the Plattsburg camp—the school of the soldier, squad and company, in close and extended order; guard duty; use and care of the rifle with sub-target and small arms practice. The armory work will include pitching and packing tents and making blanket rolls and packs. The indoor work will be followed, when weather permits, by week-end encampments and rifle shooting on the Peekskill range. Such preliminary training is especially recommended by the regular army officers.

Those who wish to attend these drills should notify Capt. George Perrine, 820 West End Avenue, New York City.

Ordered to Install Treatment Works

More than 200 manufacturing plants of Pennsylvania have been directed to install treatment plants to prevent stream pollution. The works must be completed by July 1.

News of Engineering Societies

The California Development Board will hold a quarterly session at Fresno, March 10 and 11.

The American Society of Civil Engineers will hear George Henry Ellis on "The Flow of Water in Irrigation Channels" at a meeting to be held in New York City, March 15.

The Canadian Society of Civil Engineers held a meeting at Montreal, March 2, at which a paper on "The Design of Passenger Terminals" was presented by J. L. Busfield.

The Engineers' Society of Western Pennsylvania will hear Harrison P. Eddy, consulting engineer, of Boston, Mass., on "The Extent to Which Sewage Can Be Purified by Practical Methods Now in Use" at a meeting to be held in Pittsburgh, March 7.

The Maine Society of Civil Engineers elected the following officers for the ensuing year at the annual meeting held at Augusta, Feb. 2: Paul D. Sargent, president; Harry E. Green, vice-president; Frank E. Pressey, secretary and treasurer; I. W. Barbour, John Calvin Stevens, T. W. Clark, S. A. Moulton and E. C. Jordan, directors.

The New England Waterworks Association will hold a meeting in Boston, March 8. The report of the committee on meter rates will be discussed and Robert Weston, consulting engineer, of Boston, will present a paper on "The Proposed Auxiliary Water Supply for the City of Brockton." The preliminary report of the committee on service pipe will also be received.

The Arkansas Engineering Society held its annual meeting at Helena, Feb. 22-23. Owing to the geographical location of Helena and the flooded condition of the Mississippi River, the papers and discussions were devoted almost entirely to river protection, levees and drainage. A considerable portion of the time was devoted to visiting and inspecting works of such nature. The officers elected were: James R. Rhyne, president; Louis R. Parmelee, vice-president; William J. Parkes, secretary-treasurer; Perry T. Simons and Hugh H. Humphreys, directors for two years. The next annual meeting of the Society will be held in Little Rock in the early part of 1917, the exact date to be fixed by the board of direction.

Personal Notes

F. G. HOSKINS, formerly division engineer for the Baltimore & Ohio Railroad at Philadelphia, has been appointed superintendent at Parkersburg, W. Va. Mr. Hoskins entered the service of the Baltimore & Ohio in 1907 as a bridge draftsman, being advanced to bridge inspector on the Pittsburgh division in 1908. He was made assistant division engineer at Pittsburgh in 1911, and division engineer at Connellsville in 1914, later being transferred to Philadelphia with this title.

F. Willis, of the engineering department of the Pennsylvania Steel Company, of Steelton, Pa., has been appointed superintendent of the new number 2 forge department of the plant of that company.

C. P. Ballinger, formerly city engineer, of Greenville, S. C., has been appointed consulting engineer for Greenwood, S. C. The latter city is engaged in municipal improvements to a value of $225,000.

W. F. B. Haynsworth, formerly with the U. S. Government on the construction of the Panama Canal, has been appointed city engineer of Greenville, S. C.

E. A. Taylor, formerly engineer and construction superintendent for the J. B. McCrary Company, of Atlanta, Ga., has been appointed to a similar position on the forces of the Florida Industrial Corporation at Gainesville, Fla.

T. V. Stephens, for the past two years city engineer of Cadillac, Mich., has recently been appointed by the city commission to serve as city manager of that city the coming year. He succeeds O. E. Carr, who is now city manager of Niagara Falls. He was graduated from Pennsylvania State College in civil and sanitary engineering in 1912. Previous to going to Cadillac he was connected with the division of sewerage investigation, designs and plans of the city of Cincinnati.

M. W. Parrish has resigned from the office of head of the department of manual arts at the State School at Tontsawa, Okla., to become connected with the Illinois State Highway Department.

Paul J. Merrill, formerly chief civil engineer on the erection of the experimental station for Henry Ford & Son at Dearborn, Mich., has been appointed assistant chief inspector for the Dayton Metal Products Company, of Dayton, Ohio.

Joseph C. Allison has resigned from the office of chief engineer and assistant general manager of the California Development Company, upon the transfer of that company's properties in the Imperial Valley, California, to the Southern Pacific Company, which is noted elsewhere in these pages, and will engage in private practice as consulting engineer at Calexico, Cal., specializing on flood, silt and conservation of supply problems in that section of the country. Mr. Allison was for 14 years connected with the California Development Company and the Imperial Valley development, and handled the big floods of recent years, including those of last January. He received his professional education at Stanford University in California, and served on the forces of the California Development Company in minor capacities from 1902 to 1910. In the latter year he was appointed assistant chief engineer and had direct charge of all engineering work, both design and construction, in Imperial Valley. He attained the office of assistant general manager and chief engineer in 1911.

Frederic Bass and Lee E. Rollins have opened a consulting office in the Plymouth Building, Minneapolis, for the general practices of civil and mechanical engineering, having to do with municipal works and the engineering and mechanical equipment for buildings as their specialties. Following Mr. Bass' graduation from the Massachusetts Institute of Technology in 1901 he spent three years with the Metropolitan Waterworks of Boston, one year in the U. S. Engineer Corps and fifteen years at the University of Minnesota, where he is now professor of municipal and sanitary engineering. For eight years he was in charge of the engineering for the Minnesota State Board of Health. For two years he was in private practice in municipal engineering.

Robert Lloyd, formerly with the U. S. Reclamation Service, has been appointed to a position in the valuation department of the Pennsylvania Railroad.

J. B. Weddell has been appointed city engineer of Olympia, Wash., and Ray F. Wood, assistant city engineer.

E. H. Fitzhugh and Charles J. Crowley have organized the Fitzhugh-Crowley Corporation to engage in business as engineers, constructors and railway specialists, at 60 Broadway, New York City. Mr. Fitzhugh, who will serve as president of the new corporation, entered railway service in 1873 on the St. Louis, Kansas City & Northern. After serving with various railways, including the Wabash, he went to the Grand Trunk Railway as assistant to Charles M. Hays, and aided him in putting into effect the vast physical improvements undertaken under his charge by that system. Later Mr. Fitzhugh became president and general manager of the Central Vermont Railway, in which office he remained until about a year ago. Mr. Crowley served as division engineer with Mr. Fitzhugh on the Grand Trunk Railway, during the reorganization and rehabilitation of that system, and has had a varied experience in railway location, construction and maintenance, as well as the revision of terminal and grade, and grade separation. He retired from railway service several years ago, and, after some experience as engineer with various contracting concerns on hydroelectric developments and other work, he entered the employ of Jacobs & Davies, consulting engineers, of New York City, and served as resident engineer on the Pennsylvania tunnels, as engineer and manager of construction of the McAdoo tunnels and on the subway connecting the Fourth Avenue subway, Brooklyn, with the Coney Island tracks of the Brooklyn Rapid Transit at Thirty-eighth Street, Brooklyn. Later he was superintendent and engineer of the construction of Hale's Bar dam in the Tennessee River near Chattanooga.

Earle A. Waterman, formerly professor of sanitary engineering at Pennsylvania State College, has joined the staff of E. D. Rich, state sanitary engineer, Michigan State Board of Health.

R. L. Pearson, formerly track supervisor for the New York, New Haven & Hartford Railroad at Providence, R. I., has been appointed division engineer of the New London division, with headquarters at New London.

H. M. Curtis, formerly track supervisor for the New York, New Haven & Hartford Railroad at Boston, has been appointed division engineer at that city.

R. H. Nelson has resigned from the office of assistant city engineer of Hoquiam, Wash., and will go to Chehalis, Wash., where he will assume the management of a part of a $1,000,000 logging and lumber mill project.

Samuel A. Greeley has opened an office for practice as hydraulic and sanitary engineer, at 64 W. Randolph Street, Chicago. He was graduated from Harvard University in 1903 and later took a degree in sanitary engineering at the Massachusetts Institute of Technology. For 5 years, until 1910, he was employed as assistant engineer with Rudolph Hering and George W. Fuller, working on the design and construction of works for sewerage, sewage disposal, water purification and refuse disposal, and on waterworks valuations. For three years previous to 1911 he was engaged on the construction and operation of the refuse incinerator at Milwaukee, which has a rated capacity of 300 tons per day. Mr. Greeley had charge of the operation for a year and a quarter. From 1911 to 1915 he was assistant engineer with the Sanitary District of Chicago, on investigations, designs and construction of sewers and sewage treatment plants. Mr. Greeley has made two trips to Europe, investigating and reporting upon the practice of sanitary engineering abroad, and made a trip to Caracas, Venezuela, to investigate sanitary conditions. In a private capacity, he has made many reports and plans for work for water supply, sewerage, sewage disposal and refuse disposal.

Thomas Muir and Joseph McClelland have formed a contracting firm to be known as the Muir & McClelland Construction Company, with offices in the Chamber of Commerce Building, Portland, Ore.

C. R. Rockwood, formerly in charge of the Volcano Lake works in connection with the recent flood prevention construction in Imperial Valley, has been appointed chief engineer of the development, succeeding J. C. Allison, whose resignation to engage in private practice is noted elsewhere in these columns. Mr. Rockwood has been engaged in engineering work since 1881. For 9 years he was on railroad location and construction. He was then, for a short period, deputy city engineer of San Francisco, leaving that post to enter the service of the U. S. Geological Survey on irrigation work. He was placed in charge of the Volcano Lake works in March, 1915.

Clark & Appelman, builders and general contractors, of 419 East Sixteenth Street, New York City, will move their offices to the Foster Building, Fortieth Street and Madison Avenue, as soon as that structure is ready for occupancy.

H. W. Shimer and A. J. Cleary, of the engineering department, city of San Francisco, have recently been advanced in rank by M. M. O'Shaughnessy, city engineer. Mr. Shimer becomes first assistant, succeeding Loren E. Hunt, who died recently, and Mr. Cleary will be second assistant.

Leonard Metcalf, of Boston, who has been engaged in valuation work on the Pacific Coast for some time, gave a lecture on "Engineering Valuation" in the Mining Building of the University of California on Feb. 23.

W. C. Hood and A. R. Decker, consulting engineers of Ann Arbor, Mich., have been retained by Gaylord Cummin, city manager of Jackson, Mich., to make a sewerage survey which will involve a topographic map of the city, a general resurvey of the sewers, an investigation of storm water and dry-weather flows, the design of relief storm sewers, a general consideration of sewage treatment and the necessary intercepting and trunk sewers which adequate treatment will necessitate. The work will be done in the office of H. S. McGee, city sanitary engineer, under the general direction of the consulting engineers and the city manager.

Hurlburt S. Jacoby, assistant chief engineer of the Samuel Austin & Son Company, building constructors, of Cleveland, is located temporarily at Niagara Falls, N. Y., where he is in charge of the design of an extensive addition to the Hocker Electro Chemical Company.

Bertrand D. Barker, formerly superintendent of construction for George A. Quinlan, contracting engineer, of Chicago, has been appointed assistant chief highway engineer of Cook County, Illinois. He was graduated from Norwich University, Vermont, in 1903, and served from then until 1907 as aid in the U. S. Coast and Geodetic Survey. From the latter year until 1912 he was with George Jackson, Inc., of New York City and Chicago, as engineer, general foreman and superintendent of construction and tunnel work. He became connected with George A. Quinlan in 1912.

Waddell & Son will be the consulting engineers on the design and supervision of the rebuilding of the Ohio Avenue Bridge over the Kaw River for the Kansas City Southern Railway, of which C. S. Johnston is chief engineer. The bridge will be a steel structure, costing $200,000 and consisting of 3 spans, two 300-ft. skew spans and one 215-ft. spread skew span. The American Bridge Company has been awarded the contract on the superstructure.

H. E. Astley, formerly division engineer for the New York, New Haven & Hartford Railroad at Waterbury, Conn., has been appointed trainmaster of the Midland division.

J. R. Penland has been re-elected city engineer of Albany, Ore.

Louis Mitchell, associate professor of civil engineering at Syracuse University, has been retained by the council of Tippecanoe City, Ohio, to review the flood plans of the Miami Conservancy District, with special reference to their effect upon that city.

Dr. F. W. Cunningham, of Orange, N. J., has resigned his connection with the research and development work of the Newark plant of the General Electric Company to join the engineering research staff of the Powdered Coal Engineering & Equipment Company, of Chicago.

Robert H. Anderson, formerly hydraulic engineer for the Tennessee Power Company, has been appointed chief engineer in charge of the construction of the Great Falls development for that company. He was graduated from Cornell University in 1898. From then until 1899 he served on the U. S. Deep Waterway Survey in New York, and, later, he was with James H. Fuertes, consulting engineer, of New York City, on the investigation of the New York Water Supply, and from 1900 to 1901 he served on the Nicaragua Canal surveys. He was transitman for George S. Morison on water power investigations on the Susquehanna River for the two years following, and with the U. S. Geological Survey from then until 1904, when he was appointed assistant engineer for the Isthmian Canal Commission. Previous to his connection with the Tennessee Power Company he was with the McCall Ferry Power Company.

E. A. West, formerly efficiency engineer of the Portland Light & Power Company, of Portland, Ore., has been appointed chief engineer of the Denver Tramway Company, succeeding Roger W. Toll, whose resignation is noted elsewhere in these columns.

John A. Bensel, formerly state engineer of New York, and past-president of the American Society Engineers, has been retained by the Water Service Commission of Bernardsville, N. J., to prepare preliminary plans for the water power development of dam 6 in that city.

Caleb Berry has been appointed city engineer of Centralia, Wash.

F. M. Erwin has resigned from his position with the U. S. Engineer's Office at Louisville, Ky., to accept an appointment on the forces of the Aluminium Company of America at Pittsburgh.

O. E. Weller has resigned from the office of chairman of the Maryland State Roads Commission.

Curtis A. Mees has resigned from the office of designing engineer of the Southern Power Company at Charlotte, N. C.

Dr. Henry K. Benson, professor of industrial chemistry at the University of Washington, has been appointed director of the newly established Bureau of Industrial Research, at the university.

R. B. Van Sickle, formerly construction engineer for J. A. Zimmerman & Son on the new cotton warehouses being constructed at New Orleans, and, previous to that, for several years manager for the Casper Ranger Construction Company, of New York, has formed a partnership with C. H. Wilmot to carry on a sales business in building material and equipment.

Fred R. Hesser has resigned his position as assistant engineer of the Kansas State Board of Health to become associated with the Universal Concrete Construction Company, of Kansas City. He will be supervising engineer for the company and will manage the plant for the manufacture of reinforced-concrete fence posts, telegraph poles, silo staves and other concrete units at Armourdale, Kan. Mr. Hesser became assistant engineer of the Kansas State Board of Health in 1912. Previous to that he was city engineer of Beloit, Kan.

Dr. Karl Imhoff wrote a letter to S. Fischer Miller, president of the Pacific Flush-Tank Company, dated at Essen, Germany, Jan. 27, on business matters. There had been reports circulated that Dr. Imhoff had been killed in action in the European War.

John M. Bandel, for the past three years assistant engineer in charge of construction for the Baltimore Sewerage Commission, has been appointed engineer for the Davison Chemical Company of that city. Mr. Bandel was graduated from Johns Hopkins University in 1901, and was engaged in quarry and railroad work until 1909, when he became connected with the U. S. Engineer's Office at Memphis. From 1910 to 1912 he was with the State Roads Commission of Maryland. He joined the forces of the Baltimore Sewerage Commission in the latter year.

W. W. Harmon, formerly city engineer of Grants Pass, Ore., during the construction period of the municipal railroad there, has been retained by the Oregon-Utah Sugar Company as chief engineer on the construction of its large sugar factory in that city.

Roger W. Toll has resigned from the office of chief engineer of the Denver City Tramway Company. Mr. Toll was graduated from Columbia University in 1906 and had been connected with the Denver company for the past 7 years. Previous to that he was with the U. S. Coast and Geodetic Survey.

C. E. Wright, formerly municipal and consulting engineer in private practice, has been appointed county engineer of Carrol County, Iowa, in charge of road and bridge construction.

Ray D. Armstrong, U. S. surveyor, has been transferred from the office at Spokane, Wash., to the office at Yucca, Ariz.

Albert Wolstenholme, formerly superintendent of streets of Fall River, Mass., has been named by the Mayor of that city as city engineer. Mr. Wolstenholme was appointed superintendent of streets of Fall River 3 years ago. Previous to that he had been, for 20 years, a member of the engineering firm of Wolstenholme & Buffinton. He first engaged in engineering work in 1885.

Obituary Notes

Charles E. Lawson, a retired contractor, of New York City, died at Allentown, Pa., Feb. 20. He was 66 years old.

Charles W. Milholland, resident engineer for the Baltimore & Ohio Railroad at Cincinnati, died in that city, Feb. 23. He was in the service of the Baltimore & Ohio for 20 years, and supervised the construction of many of its important structures.

Jacob C. Jamerson, formerly a contractor, of Seattle, Wash., died in Tacoma, Feb. 21. He was 77 years old. Mr. Jamerson came to Seattle from St. Louis in 1887.

J. W. White, a retired contractor and builder of Spokane, Wash., was recently killed while alighting from a Great Northern train at Loon Lake, Wash.

John M. Eshleman, from 1911 to 1914 president of the California Railroad Commission, died at Indio, Cal., Feb. 28.

Civil Service Examinations

United States.—An open-competitive examination for junior civil engineers, Grades 1 and 2, salaries from $1,200 to $1,680 and $720 to $1,080 respectively, will be held March 22 and 23 at the usual places. These positions are in connection with the Interstate Commerce Commission on the valuation of the property of railroads. Applicants for the examination for civil engineers of grade 1 will be obliged to show that they have had either five years' experience in civil engineering, two of which must have been railway civil engineering, or a civil engineering education in a recognized school and two years' experience, one of which must have been railway civil engineering, while those of grade 2 must prove that they have had either two years' experience in engineering as civil engineers, structural engineers or supervisors of building construction, or an education equal to three years of a recognized technical school. The age limits are between twenty-one and thirty-six years. The application form for both examinations may be secured from the United States Civil Service Commission at Washington, D. C., or anyone of the civil service boards throughout the country, by specifying form 2039 and the title of the examination.

Another open-competitive examination is announced for laboratory assistant, Bureau of Standards, salary from $900 to $1,200 a year, to be held on April 12-13. The requirements for participating in this examination include a thorough knowledge of physics and civil, mechanical or electrical engineering. The age limit is between twenty and thirty-five years. It is suggested that applicants desiring to take the examination should apply for a copy of the Manual of Examinations for the spring of 1916, and form 1312, giving the title of the examination. Application may be made through the same sources given above.

Philadelphia.—The Civil Service Commission announces examinations, open to residents of the city, for positions enumerated below, to be held on the dates given. Applications must be secured and filed with the commission four days before the date of examination. Forms may be obtained from the commission at room 976, City Hall. The examinations are for:

Assistant Engineer in charge of testing laboratory, Bureau of Surveys, salary $3,000 a year, to be held March 10 and 11. The duties of this position include the directing of physical and chemical testing of cement, concrete, steel, paints, oils, waterproofing compounds, asphalt, coal, building stone, paving brick, and other materials, and the making of investigations required in connection with the testing laboratory work. Applicants must be at least thirty years of age, and have had eight years' active laboratory experience.

Architectural Draftsman, salary from $900 to $1,200 a year, to be held April 3 and 4. Applicants shall have had six months' experience and a definite knowledge of the principles of architectural drafting. The work is making details and drawings, and elevations and perspectives of building construction.

Architectural Draftsman, salary from $1,200 to $1,500 a year, to be held April 5 and 6. The qualifications for this position are similar to that noted above. The duties, of course, will be of a more responsible nature commensurate with the difference in salary.

Assistant Engineers, Highway Department, salaries $2,100 and $2,500 a year, to be held April 7 and 8. The duties for the lesser position include general supervision of the construction, inspection and maintenance of highways, bridges and sewers, so far as they are a part of highway work, and also the work of employees in this department. The applicant must be a civil engineer and have had two years' experience in road work. The better position, on the other hand, includes, as duties, besides this general supervision, that of office work and correspondence. The applicant for this examination must also have a civil engineering training and three years' experience in highway work.

Rodman, City Transit Department, salary from $840 to $960 a year, to be held April 4. To assist in making surveys and giving lines for the construction of subway and elevated structures. Candidate must have the necessary mathematical knowledge to understand the use and adjustment of the transit, the reading of rods, chaining, and keeping notes, and to compute and plot surveys or quantities of materials entering into construction. This will necessitate a year's experience at least in surveying work.

Consider Building Chain of Automobile Plants in Russia

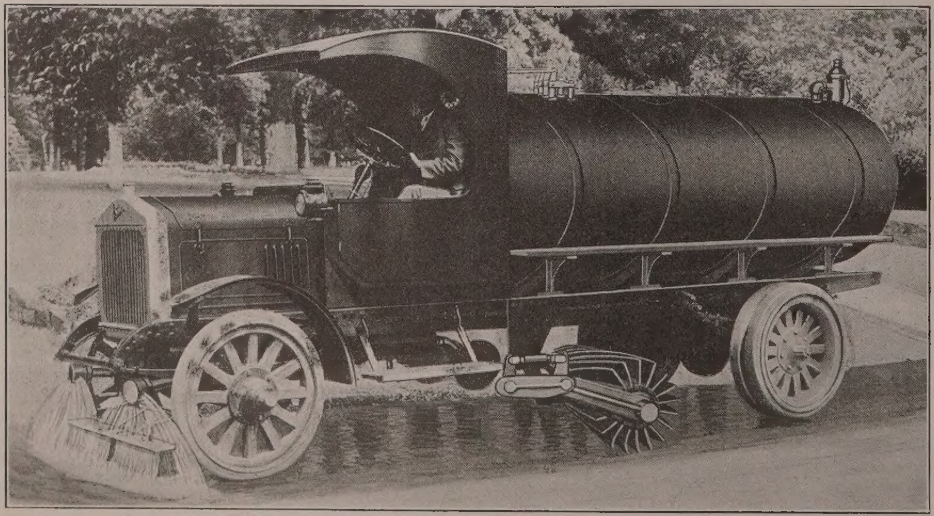
Benton Hopkins, representing Samuel Austin & Son Company, engineers and builders of Cleveland, and the Morgan Engineering Company of Alliance, Ohio, sailed for Russia, Feb. 22, to open the way for the construction of a string of automobile plants. The plant, immediately under consideration, is the first one of a group of 27 large self-contained plants of various kinds, which are to be erected in Russia as a part of a movement for placing that country on the map industrially. A group of influential Russian people are back of the project, and are very much in earnest in making the country as independent as possible from outside countries in the procuring of the manufactured articles which are needed. The first plant will be used for the manufacture of automobiles and motor-trucks.

Motor Squeegee Street Washer Removes Impacted Filth

A motor driven street washer that is said to clean a street as a rubber squeegee cleans a window, and which, it is claimed, will remove impacted dirt and filth in a manner impossible by ordinary methods has been put on the market by the Sterling Motor Truck Company, of West Allis, Milwaukee, Wis., under the name of the Sterling-Kindling motor squeegee street washer.

The machine consists of a special Sterling worm-driven chassis upon which is mounted a 1000-gal. steel tank. Immediately in front of the front fenders are two flusher nozzles controlled by the driver by means of a lever. The nozzles by sprinkling the surface of the street prevent the agitation of dust, and also dampen the attached matter so that the squeegee roller can force it loose from the pavement, and wash the surface clean. Supplementing the function of the nozzles in loosening the attached matter, and to prevent the squeegee from being compelled to handle too large a mass of material, a pair of heavy pavement sweeping brooms are fitted behind the front nozzles, the purpose of which are to force aside the large refuse so that it will be suspended in the water, leaving the squeegee to wash up the tightly adhered material by frictional action. Mounted near the center of the chassis frame, and underneath it, is a squeegee 19 in. in diameter, and 8 ft. long. Each rubber spiral is easily detachable, and is mounted in a special kiln-dried wood holder of large wearing surface. The squeegee attachment is flexibly mounted and counterbalanced in such a way that when adjusted to a certain pressure, it is impossible for the roller to work loose, and the pressure against the surface of the street is uniform, the rubber strips being 6 in. deep and affording large wearing surface. A toggle joint linkage terminating in a lever in the driver's cab, enables him to easily and quickly place the squeegee attachment in and out of engagement with the street and, when returning from washing a section of street, to lift the roller out of contact with the pavement.

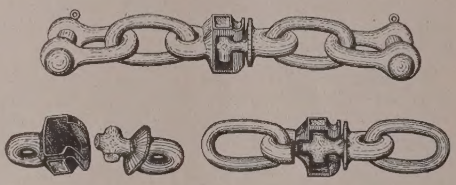
The tank is fitted with a water meter which indicates the amount of water flowing through it. It contains four valves near the front end for distributing water to the front and to the side nozzles near the squeegee roller.



BROOMS FORCE ASIDE LARGE REFUSE AND SQUEEGEE LOOSENS ATTACHED MATTER

Car Coupling Breaks Sidewise

A mine car coupling designed to come undone in a second when broken sidewise, but to stay locked all day unless released on purpose, has been put on the market by the Macomber & Whyte Rope Company, of Chicago. It is made in two styles, fitting either horizontal or vertical drawbars. That for the latter kind is shown in the illustration, which makes the method of operating the coupling apparent. It is claimed for these couplings that they are rugged and simple to use, and are not affected by much ice or other conditions which often make the switching of contractors' rolling stock one continual delay.

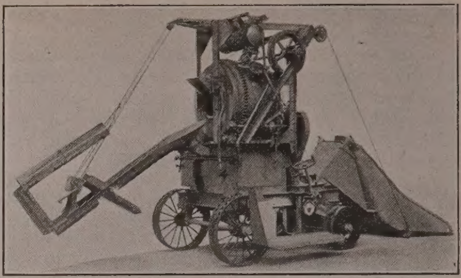


COUPLING HAS NO LOOSE PARTS

High-Drum Mixer Has Sectional Chute

A raised drum, 6½ ft. from the ground to the discharge chute, is a feature of the new line of paving mixers brought out by the Koehring Machine Company, Milwaukee, shown for the first time at the Chicago Cement Show. The delivery chute is in sections, as shown in the photograph. By turning the crank operating a compensating gear at the cable-supported end of the chute, the sections may be lowered to deliver concrete from each of them at the same level. As a section is taken or added to the end of the spout the chute is lowered or raised respectively.

Other features of the new line, called the "Dandie," are the universal type of bearing to insure automatic alignment and the slots in the reversible front wheels into which a driving gear meshes, thus eliminating an extra cast gear. All operations of these pavers, which are made in 10 and 20-cu. ft. dry capacity, are controlled by one man from levers at the side.



DELIVERY CHUTE FITTED IN SECTIONS

Batch mixers of 5 and 10-cu. ft. capacity with low charging platform or side loader complete the "Dandie" line.

Business Note

The Concrete Steel Company, 42 Broadway, New York City, has opened a district sales office at Birmingham, Ala. The office will be under the personal direction of William Piez, who has had a long experience in handling reinforcing bars and concrete specialties.

Trade Publications

The following companies have recently issued trade literature:

Smith Engineering Works, Milwaukee, Wis., booklet, 24 pages, portable crushing plants, a plain talk to Bill Jones.

Alexander Milburn Company, Baltimore, Md., catalog, 52 pages, portable acetylene lights for outdoor illumination; oxy-acetylene generator.

National Tube Company, Pittsburgh, catalog, 72 pages, the whole Kewanee line of specialties; unions, couplings, joints, valves, etc.

Pneumatic Placing Company, 2 Rector Street, New York, circular, 4 pages, pneumatic-concrete-mixer installation on self-propelled material railway car.

Link-Belt Company, Chicago, book 249, 24 pages, reprint, "Insuring the Coal Supply," by H. J. Edsall, describing apparatus for handling and storing coal.

Thew Automatic Shovel Company, Lorain, Ohio, circulars 22, 24 and 26; 12 pages, 6 pages and folder respectively, full-circle shovels and combination boom shovel.

Blaw Steel Construction Company, Pittsburgh, bulletin 68, 12 pages, reprint of an article on concrete construction and design of water tower-tank at Middleboro, Mass.

Brown Hoisting Machinery Company, Cleveland, Ohio. Catalog D, 1916, 6 x 9 in., 64 pages, illustrated. Describes the Brownhoist tramrail system, trolleys and electric hoists in their application to power plants, factories and warehouses.

E. I. du Pont de Nemours & Company, Wilmington, Del. Booklet, 6 x 9 in., 128 pages, illustrated; a handbook on high explosives, first section. Instructions as to the best and safest methods of handling, thawing, priming, and firing explosives are contained in this booklet. The opening paragraphs describe the du Pont plant and organization, the balance of the text dealing entirely with the problems of explosives. In the chapter on thawing, besides the suggestions on how this operation should be and should not be performed, there are contained numerous drawings, illustrating houses and systems best adapted for this work. Likewise, on priming and firing there are included illustrations, showing the right practice; in connection with the latter, the various uses to which dynamite is put are enumerated and described in detail. The latter part of the book is devoted to "don't" advices and a glossary. The entire set, first and second sections, which may be secured from the du Pont company, is without doubt a valuable adjunct to every contractor's library, no less for the simple advice they contain than for the innumerable hints for handling explosives.